"MAGNITUDE AND PREDICTORS OF SUBCLINICAL HYPOTHYROIDISM IN PATIENTS WITH IMPAIRED GLUCOSE TOLERANCE"

Thesis submitted to the faculty of

ALL INDIA INSTITUTE OF MEDICAL SCIENCES, BHOPAL

For the award of the degree of MD in the subject of

GENERAL MEDICINE

By

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The decision of the committee is as follows:

The AIIMS, Bhopal IHEC-SR approves your research protocol. All research related activities must begin only after the date of this approval. The validity of this approval is till two years from the date of issuance. Please submit a closure report / renewal request before expiration of the validity for this approval.

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by tejaswita chourey

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LIST OF ABBREVIATIONS:

AACE	American Association of Clinical Endocrinologists
ACTH	Adreno Cortico Trophic Hormone
ADA	American Diabetes Association
AgRP	Agouti-Related Peptide
AIIMS	All India Institute of Medical Sciences
AMPK	Adenosine mono phosphate Kinase
anti-PD-1	anti Programmed Cell Death Protein 1
anti-TPO ab	anti-thyroid peroxidase antibody
ASHA	Accredited Social Health Activists
ATA	American Thyroid Association
BAI	Body Adiposity Index
BAT	Brown adipose tissue
BAT	Brown Adipose Tissue
BMI	Body Mass Index
CBG	Capillary blood glucose
CGM	Continuous Glucose Monitoring
CI	Confidence Interval
CKD	Chronic Kidney Disease
CLD	Chronic Liver Disease
COAD	Chronic obstructive airway disease
CTLA4	Cytotoxic T-lymphocyte associated protein 4
CVD	Cardiovascular Disease
D2/D3	Type 2 Deiodinase /Type 3 Deiodinase
DASH	Dietary Approaches to Stop Hypertension
DBP	Diastolic Blood Pressure
DKA	Diabetic ketoacidosis
DM	Diabetes Mellitus

ER	Endoplasmic reticulum
FPG	Fasting plasma glucose
FT4	Free Thyroxin
GDM	Gestational Diabetes Mellitus
GIT	Gastrointestinal tract
G6PD	Glycerol 6 Phosphate Dehydrogenase
GLP-1	Glucagon-Like Peptide-1
HDL	High-Density Lipid
HFrEF	Heart Failure with Reduced Ejection Fraction
HHS	Hyperosmolar Hyperglycemic State
HOMA-IR	Homeostatic Model Assessment for Insulin Resistance
HR	Heart rate
HTN	Hypertension
ICMR-INDIAB	Indian Council of Medical Research-India Diabetes
IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
IR	Insulin Resistance
ITT	Insulin tolerance test
JAK	Janus Activated kinase
KNHANES	Korean National Health and Nutrition Examination Survey
LDL	Low-Density Lipid
LT4	Levothyroxine
LXR	Liver X receptor
MAP	Mean Arterial Pressure
MC4R	Melanocortin 4 receptor
MCT	Medium Chain Triglycerides
NCD	Non-communicable disease
NCEP ATP III	National Cholesterol Education Program Adult Treatment Panel III
NPCDCS	National Program for prevention of Cancer, Diabetes, cardiovascular disease and stroke

NPY	Neuropeptide Y
NTI	Non-Thyroidal illness
OGTT	Oral glucose tolerance test
PCOS	Polycystic Ovary Syndrome
PEPCK	Phosphoenolpyruvate carboxykinase
PGC-1 alpha-	PPAR gamma coactivator-1 alpha
PGK	Phosphoglycerate kinase
POMC	Pro-Opiomelanocortin
PPAR	Peroxisome proliferator-activated receptor
RCP	Royal College of Physicians
SBP	Systolic Blood Pressure
SGLT	Na+ glucose cotransporter
SH	Subclinical Hypothyroidism
T3/T4	Triiodothyronine/Thyroxine
TBW	Total body water
TFT	Thyroid function test
TNF-α	Tumor Necrosis Factor-alpha
TPO-Ab	Thyroid peroxidase antibody
TR	Thyroid hormone receptor
TRH	Thyrotropin-releasing hormone
TSH	Thyroid-Stimulating Hormone
TZD	Thiazolidinediones
UCP	Uncoupling Protein
UPHC	Urban Primary Health Centers
USPSTF	U.S. Preventive Services Task Force
VLDL	Very Low-Density Lipid
WAT	White Adipose Tissue
WHO	World Health Organization
WHR	Waist-Hip Ratio
WSR	Waist-to-Stature Ratio

Introduction

Impaired Glucose Tolerance (IGT) is when blood sugar levels are higher than normal but not high enough to be classified as diabetes.(1) It is an intermediate state of hyperglycemia and is often considered a pre-diabetic condition.(2) The increasing prevalence of IGT worldwide is attributed to factors like the obesity epidemic, lifestyle changes, and aging populations. Globally, more than half a billion adults suffer from IGT, and this number is expected to rise. People with IGT have an increased risk of developing type 2 diabetes, cardiovascular diseases, and other metabolic disorders.(3) In 2021, the **International Diabetes Federation (IDF)** reported that **541 million adults** globally (10.6% of the population aged 20-79) have **Impaired Glucose Tolerance (IGT)**, with this number expected to rise to **730 million** by 2045. In **India**, the **ICMR-INDIAB study** estimated that **10.3% of adults** suffer from IGT, with significant regional variations reflecting the growing burden of diabetes and prediabetes in the country due to urbanization, lifestyle changes, and rising obesity.(4–7)

Subclinical hypothyroidism (SH) is a mild form of underactive thyroid function where the thyroid gland produces inadequate levels of thyroid hormones but not enough to cause obvious or overt symptoms of hypothyroidism. It is characterized by an elevated thyroid-stimulating hormone (TSH) level, while the levels of the thyroid hormones thyroxine (T4) and triiodothyronine (T3) remain within normal reference ranges. (8)

The prevalence of subclinical hypothyroidism (SH) varies globally and within India. On a global scale, the prevalence is typically between 4-10%, with variations depending on geographic regions, iodine intake, and population demographics. In iodine-replete areas, the prevalence tends to be higher due to autoimmune causes. In contrast, regions with iodine deficiency show lower rates but may still exhibit significant numbers due to thyroid autoimmunity. (9–11) In India, recent studies indicate a wide variation in prevalence across different regions, reflecting differences in iodine nutrition and population characteristics. Nationally, estimates suggest that around 9-14% of the general population may have SH, with some regions showing much higher rates. For instance, studies in Northern India have found a prevalence of about 10.25%, while certain studies in Kashmir report rates as high as 24-33%. In South India, SH prevalence is lower, typically around 9.4%, depending on iodine sufficiency. Women tend to have a higher prevalence than men, and rural and tribal populations often show elevated rates, especially in areas with historical iodine deficiency. (10,12–14)

Screening for Thyroid function abnormalities in asymptomatic adults is debated. American Thyroid Association recommended in 2000 and 2004 that all adults above 35 should be screened for thyroid disease by performing Thyrotropin (TSH) levels every five years. (15,16) However, other scientific societies have argued against such screening or expressed ambiguity due to insufficient evidence of its benefit (Institute of Medicine 2003, US Preventive Task Force 2004; American Association of Family Physicians 2010).(16–18) As per the British Thyroid Association statement 2006, if at all such a screening is performed, TSH levels should be repeated after 3-6 months. The basis for these recommendations is that about 40 percent of patients with subclinical thyroid dysfunction may revert to normal when followed over time, and only 2 to 5 percent of persons with subclinical hypothyroidism (SH) develop overt thyroid disease. (19) Further, the prevalence of SH is low. In the US, the estimates ranged from 1.2% in African American Women to 5.8% in Caucasian women. (20) Prevalence is lower in men compared to women and lower in young compared to the elderly. (21)

Further, arguments favor screening and early identification of SH, including the availability of simple screening tests such as serum TSH levels and the low cost of levothyroxine therapy if treatment is contemplated. One recent cohort study from the US with a median seven-year follow-up found that those with SH have a higher risk of future cardiovascular disease (CVD) (HR 1.90, 95%CI 1.14-3.19). (22) On the contrary, previously published meta-analyses were neutral. (23,24) Another systematic review has reported no benefit of treating SH with levothyroxine. (25)

Despite the lack of definitive evidence in favor of screening or treatment of SH, such screening is often advocated due to the association of abnormal thyroid physiology with dyslipidemia, abnormal cardiac function, endothelial dysfunction, and atrial fibrillation. (26) Cardiovascular guidelines recommend TSH-based screening of all individuals with hypertension.(27,28) While there is a potential physiologic link between secondary hypertension and hyperthyroidism, the prevalence of the latter condition is lower than a hypothyroid state. (29) Cross-sectional surveys have found an association between hypertension (HTN) and SH. (30) Among individuals with diabetes mellitus (DM), there are specific thyroid disorder screening

recommendations in individuals with T1DM. (31) While 2006 British guidelines suggested a TSH-based screening in individuals with T2DM, the basis and need for such a screening is unclear. (32) Yet, early screening for SH in patients with diabetes is advocated by some researchers.(33) Despite TSH-based screening being done in individuals with intermediate to high CVD risk (such as those with metabolic syndrome, hypertension, or diabetes), there is a lack of literature on formal evaluation of such a strategy. (32)

Hypothyroidism is associated with insulin resistance and glucose intolerance. (34) It also results in impaired glucose absorption from the GIT, delayed peripheral glucose assimilation, and gluconeogenesis. (35) This deterioration of glucose metabolism is also seen in SH. (36) It is postulated that treating SH will reverse insulin resistance and normalize impaired glucose tolerance (IGT). (37) In one recent study from the Netherlands, the risk of progression from prediabetes to diabetes was higher with low-normal thyroid function (HR 1.32 95%CI 1.06-1.64) as determined by elevated TSH levels. (38) The impact of hypothyroidism on glucose metabolism is complex and sometimes contradictory. On one hand, hypothyroidism is considered a potential cause of hypoglycemia, warranting evaluation in cases of unexplained low blood sugar. On the other hand, some studies—but not all—have found a link between hypothyroidism and insulin resistance. The effects of subclinical hypothyroidism on glucose metabolism are likely to be more subtle and have been less thoroughly studied, with previous research producing mixed results.

The research question of our study was to determine the feasibility of TSH-based screening and the burden of SH amongst individuals with IGT in a community-based setting. We also aimed to determine if those adults with IGT who were also classified as SH at baseline, as compared to those who did not, had a higher risk of worsening their glycemic parameters over one year of follow-up.

Review of Literature

Background

Recent epidemiological studies have indicated a higher prevalence of hypothyroidism in patients with type 2 diabetes (T2DM) compared to the general population. However, most of these studies have focused on hospital-based or elderly populations. Additionally, many reports limit their focus to one specific type of thyroid disease in diabetic patients, and no comprehensive study has been conducted on the prevalence of various thyroid abnormalities across different glucose tolerance statuses in the general population. Both thyroid disorders and hyperglycemia, particularly impaired glucose tolerance, are widespread global health issues. Thyroid dysfunction, especially subclinical hypothyroidism, affects metabolic regulation and has been associated with insulin resistance and glucose intolerance. The co-existence of hyperglycemia and thyroid disorders worsens health outcomes, as studies show a significant overlap, particularly among individuals with metabolic syndrome. An undiagnosed thyroid disorder can impair metabolic control and increase the risk in patients already predisposed to T2DM. Understanding the spectrum of these conditions is essential for identifying shared risk factors, improving early diagnosis, enhancing treatment approaches, and addressing the growing burden of these interconnected disorders, especially in populations like those in India. (1)

Thyroid hormone disorders and SH

Primary hypothyroidism can be classified as **overt hypothyroidism** when TSH values exceed>10 mU/L (nonpregnant) and **SH** when TSH values are between 4.4 and 10 mU/L. SH, also called mild thyroid failure, is diagnosed when TSH is persistently elevated (12 weeks or longer) with normal free T4. Previously, ATA and Endocrine Society launched recommendations for an upper reference limit of TSH of 2.5 mU/L in the first trimester and 3.0 mU/L in the second and third trimesters. (2) However, recently, significant geographic and ethnic diversity in TSH concentrations during pregnancy has been found. Thus, the latest guidelines from the ATA stated that population-based trimester-specific reference ranges for serum TSH should be defined by assessing local population data representative of a healthcare provider's practice.

Prevalence of SH varies from 4% to 20% in the general population. (3) There is a higher prevalence of SH in women, individuals with suboptimal thyroid status, the elderly, and those with thyroid autoimmunity. About 70% of patients are asymptomatic. Symptoms are nonspecific and similar to overt hypothyroidism, like fatigue (most common), weakness, cramps, weight gain, constipation, impaired concentration, and anxiety. (4)

Consequences of subclinical hypothyroidism

- **Progression to overt hypothyroidism:** The natural history of SH is that it can either progress to overt hypothyroidism or have spontaneous recovery. The annual rate of progression is 3-18%. Risk factors for progression include older individuals, female gender, and elevated anti-TPO antibody titers. (5)

- **Cardiovascular disease:** A strong association is seen between SH and cardiovascular diseases like CAD and heart failure in patients of less than 65 years of age, which may be explained by atherogenic lipid profile (elevated cholesterol, LDL), increased carotid intima-media thickness, high SBP, and DBP. Reported cardiac abnormalities are impaired left ventricular diastolic and systolic dysfunction (secondary to altered intracellular calcium handling). (6,7)

- **Pregnancy outcomes:** Undetected SH in pregnancy can lead to spontaneous abortion, preeclampsia, gestational HTN or diabetes, premature birth, low birth weight, and poor developmental outcomes in offspring. GDM is associated with worse pregnancy outcomes, but the certainty is unknown about the relationships between IGT and worse pregnancy outcomes, and the authors also found that SH is associated with an increasing risk of IGT but does not increase the risk of the development of GDM. (8)

- Studies have shown that 30-60% of individuals with SH and overt hypothyroidism had USG findings of NAFLD, 10-26% had altered liver enzymes, and 26% had fibrosis. SH was associated with depression and cognitive dysfunction.(9,10)

- A retrospective cohort analysis to identify changes in body composition according to baseline TSH and ΔTSH levels in euthyroid patients suggested body weight and body fat percentages increase in hypothyroidism, and muscle weakness occurs in subclinical hypothyroidism. Although the mechanism is unclear, it is known to be due to decreased thermogenesis and fat tissue metabolism. (11)

TSH values depend on age, gender, ethnicity, BMI, and pregnancy status. The diagnosis of hypothyroidism relies upon laboratory tests because of the lack of specificity of clinical manifestations. The American Thyroid Association (ATA) and the American Association of Clinical Endocrinologists (AACE) recommend measurement of TSH as the initial test in any individual at risk of hypothyroidism- that is associated with other autoimmune disease, history of neck radiation/ thyroidectomy, family history of thyroid disease, age more than 60 years with repeat screening every five years.(12)

The natural course of subclinical hypothyroidism and factors affecting TSH level

The evolution of TSH levels in SH patients is variable. Some cases of TSH may return to lower levels over the years, but others may not, possibly even developing into overt thyroid failure, which is also variable. A longitudinal, observational, retrospective study consisted of 155 patients with a mean age of 7.8years ±3.6SD; the Baseline mean TSH level was 7.8mU/L (5.03-15.8mU/L). TSH levels normalized after the first repeated measurement during the subsequent month in 60% of cases. (13) A prospective study on the natural progression of idiopathic subclinical hypothyroidism (SH) in children and adolescents found that TSH levels in this population tend to decrease over time progressively. The majority of patients (88%) either normalized or maintained stable TSH levels. (14) In individuals over 55 years old, TSH concentration is the strongest predictor of the outcome for spontaneous subclinical hypothyroidism, with those showing mildly elevated TSH levels having a low incidence of developing overt hypothyroidism. (15)

A retrospective study highlighted that an initial elevated TSH level is a reliable prognostic factor for subclinical hypothyroidism (SHT). At the same time, thyroid peroxidase antibody (TPO-Ab) titers are also helpful, particularly in cases with mildly elevated TSH. However, the study's narrow range of TSH levels (5 to 7 μIU/mL for 59.5% of subjects) and short follow-up period (less than 12 months) limited its ability to detect significant correlations across a broader range of TSH values. Despite most subjects having normal TPO-Ab levels (<60 U/mL), the researchers suggest that with a more diverse data set and extended follow-up, TSH and TPO-Ab might emerge as more robust predictors of SHT. Age-related increases in TSH values, particularly in those over 60, call for cautious interpretation. At the same time, factors like autoimmune conditions, medications (causing hypothyroidism—such as amiodarone, lithium, interferon, antidopaminergics, bexarotene, corticosteroids, anti-CTLA4, and anti-PD-1 all of which may modify thyroid tests, and also by interference from antibodies such as heterophils), and lifestyle (e.g., smoking, iodine intake) ethnicity and heritability can also affect TSH levels. The study emphasizes that monitoring TPO antibodies and ultrasonography to detect autoimmune thyroiditis enhances diagnostic accuracy.(16)

Factors affecting serum TSH levels

1. Nocturnal measurements of TFT
2. Assay variability
3. **Obesity**: Increased leptin secretion in obese patients can promote TRH secretion, leading to higher serum TSH levels.
4. **Drugs**: Medications like anti-thyroid agents, rifampicin, and especially amiodarone can raise TSH levels, sometimes up to 20 mIU/L.
5. **Adrenal insufficiency**: Primary adrenal insufficiency or isolated ACTH deficiency can mildly raise TSH levels; hydrocortisone should be given before LT4 treatment.
6. **Hypothalamic hypothyroidism**: It can cause mild TSH increases and decreases in FT4, sometimes mimicking SH.

7. **Overt hypothyroidism treatment**: Poor compliance with LT4 or early stages of overt hypothyroidism can result in mildly elevated TSH despite normal FT4.
8. **Non-thyroidal illness (NTI)**: Conditions like cancer cachexia can mimic SH in thyroid function tests.(17)
9. Presence of heterophile antibodies interfering with TSH assays
10. Thyroid hormone resistance.(18)

Variable TSH levels could be related to iodine intake, smoking, ethnicity, and 64% by heritability. Despite the evidence of a link between TSH levels and a greater probability of overt hypothyroidism, such as those indicating 7 to 10 mIU/L, it is not possible to define a single cutoff point due to the significant differences in levels between countries and ages, which, when combined with lifestyle, generates an impact on quality of life. The general population has no association between thyroid function (TSH, FT4) and physical activity levels.(19)

When to treat subclinical hypothyroidism: Treatment in patients with subclinical hypothyroidism should be individualized depending on the following factors-

- TSH: <10 or >10 mU/L
- Age: >65 or <65 years
- Comorbidities: Presence of CVD, heart failure, dyslipidemia, obesity
- Clinical profile: Clinical features, goiter, TPOAb, pregnancy, infertility, intention of pregnancy.

Treatment of SH

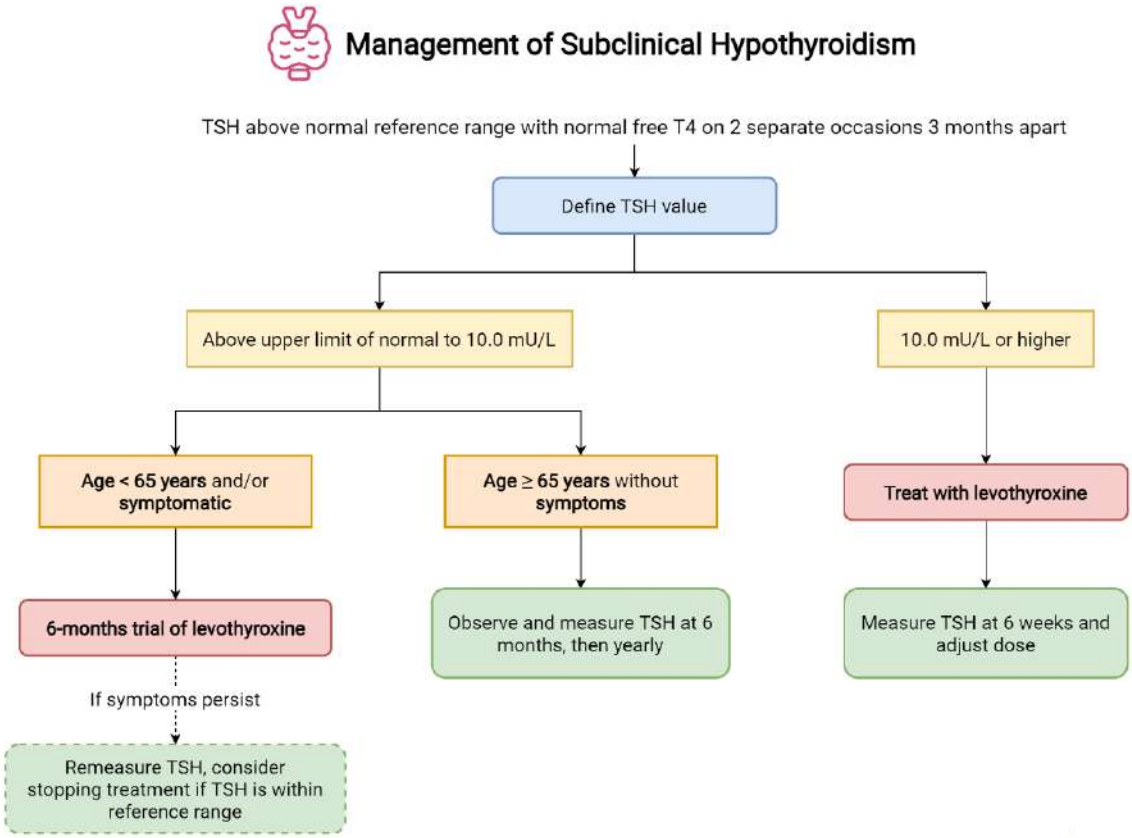
Guidelines recommend initiating therapy with the lowest necessary dose to normalize serum TSH, typically 25-50 mcg of L-thyroxin. Serum TSH should be repeated 8-12 weeks after initiation of therapy, with target TSH ranging 0.5-2.5 mU/L in young and middle-aged patients. In patients >65 years of age, a higher TSH target of 3-5 mU/L is

recommended. The dose of L-thyroxine should be increased with a minimum dosage of 12.5-25mcg. Once target TSH is achieved, TSH should be repeated after six months and then annually. However, based on current evidence, raising the target serum TSH levels to 4-6 mIU/L in patients over 70-80 years old is reasonable.

LT4 supplementation should start with a low dose (12.5-25 μg/day) with gradual increases based on symptoms and serum TSH levels in heart disease or suspected heart failure. In pregnancy, trimester-specific references are recommended. The recommended L-thyroxine dosage is 1.2 mcg/kg/day. American Thyroid Association (ATA) suggests thyroxin should be administered in pregnant women with a combination of positive TPO Ab and serum TSH level> upper limit of each trimester or TSH >2.5 mIU/L; serum TSH level >10mIU/L alone or a negative TPO Ab but serum level of TSH > upper limit of each trimester to reach the threshold of serum TSH levels <2.5 mIU/L during pregnancy under thyroxin therapy. (8,20,21)

It should not be taken with other liquids, such as coffee, green tea, or milk, which may interfere with LT4 absorption. Before LT4 supplementation, adrenal insufficiency should be ruled out. Otherwise, the adrenal crisis may develop upon supplementation. It is important to note that serum TSH levels below 0.1 mIU/L, indicating excessive LT4 supplementation, may be linked to adverse outcomes, such as an increased risk of cardiovascular diseases and osteoporosis, particularly in older adults and postmenopausal women. In the near future, a target TSH in the age-specific reference range should be determined by randomized controlled trials of LT4 supplementation in patients with SH.(17)

Figure 1: Management of SH


Management of Subclinical Hypothyroidism
TSH above normal reference range with normal free T4 on 2 separate occasions 3 months apart
Define TSH value
Above upper limit of normal to 10.0 mU/L
10.0 mU/L or higher
Age < 65 years and/or symptomatic
Age ≥ 65 years without symptoms
Treat with levothyroxine
6-months trial of levothyroxine
Observe and measure TSH at 6 months, then yearly
Measure TSH at 6 weeks and adjust dose
If symptoms persist
Remeasure TSH, consider stopping treatment if TSH is within reference range

Source: NICE CKS **https://cks.nice.org.uk/topics/hypothyroidism/#!scenario:1**

Note: Giving Levothyroxine to all patients with SH who are less than 65 years of age is optional, and some guidelines (give example) recommend treatment only in compelling situations (e.g., pregnancy, infertility, etc.)

Insulin resistance

Insulin resistance is a disorder of glucose regulation in which muscles, adipose tissue, the liver, and other tissues become less responsive to insulin, even when its levels in the blood are normal or elevated. This condition may be asymptomatic or manifest through various disorders, such as impaired glucose tolerance, type 2 diabetes, high cholesterol, elevated triglycerides, obesity, and high blood pressure. Insulin resistance can be classified as

peripheral or hepatic. Peripheral insulin resistance affects skeletal muscles and adipose tissue, leading to impaired glucose uptake in muscles, increased fat breakdown in adipose tissue, and elevated release of free fatty acids. Hepatic insulin resistance involves heightened glycogen breakdown, increased glucose production, and elevated VLDL cholesterol and triglyceride fraction production by liver cells. (22)

Rochon et al. investigated insulin sensitivity across various tissues in patients with hypothyroidism and found that the condition leads to reduced insulin-dependent glucose utilization, which can be reversed with proper treatment. Similar findings were reported by **Stanicka et al.** and, Handisurya et al., Maratou et al., showed that patients with overt hypothyroidism (HO) and subclinical hypothyroidism (SHO) experienced decreased insulin-stimulated glucose transport in monocytes due to impaired translocation of GLUT4. Another factor contributing to insulin resistance in hypothyroidism is reduced blood flow to peripheral tissues. In some studies where insulin resistance was not detected in SHO patients, fasting hyperinsulinemia—an early indicator of impaired glucose metabolism—was observed. Thyroid hormones play a crucial role in glucose metabolism and the development of insulin resistance. In hyperthyroidism, impaired glucose tolerance is primarily linked to hepatic insulin resistance, while in hypothyroidism, the available data suggests insulin resistance occurs mainly in peripheral tissues.(23,24)

A meta-analysis by **Ding et al.** found that subclinical hypothyroidism is associated with an increased risk of metabolic syndrome and its components.(25) Whereas other meta-analyses found no significant difference in metabolic syndrome prevalence between subclinical hypothyroid and euthyroid individuals.(26)

Metabolic syndrome: According to NCEP ATP III (National Cholesterol Education Program Adult Treatment Panel III) and WHO, to be diagnosed with metabolic syndrome, a person must have at least **three out of five** parameters(27):

Table 1: Parameters for diagnosis of metabolic syndrome

Parameters	Threshold
1. Waist circumference (central obesity)	≥102 cm (40 inches) for men ≥88 cm (35 inches) for women
2. Blood pressure	≥130/85 mmHg or on antihypertensive treatment
3. Fasting blood sugar	≥ 100 mg/dL (5.6 mmol/L) or on treatment for elevated blood glucose.
4.S. triglyceride	≥150 mg/dL (1.7 mmol/L) or on treatment for elevated triglycerides.
5. HDL cholesterol	<40 mg/dL (1.03 mmol/L) in men <50 mg/dL (1.3 mmol/L) in women or on treatment for reduced HDL

According to the International Diabetes Federation **(IDF),** for a diagnosis of metabolic syndrome, a person must have central obesity (defined as waist circumference with ethnicity-specific values) along with two or more of the other listed parameters.(28)

Anthropometry measures: These are typically used in assessing health risks such as obesity, cardiovascular disease, and metabolic syndrome.

- Neck Circumference: Often used in studies to predict cardiovascular and metabolic risks.
- Waist Circumference: A central measure of adiposity; higher values indicate a higher risk of metabolic disorders.
- Hip Circumference: Paired with waist circumference for WHR calculation, larger hips often indicate a lower risk of heart disease.
- Body Mass Index (BMI): the simple measure used to assess body weight relative to height and is calculated using the formula: BMI=weight (kg)/height (m)2

- Waist-to-Hip Ratio: Simple and effective for assessing body fat distribution and health risks.
- Waist-to-Stature Ratio: A more accurate predictor of obesity-related health risks than BMI.
- Body Adiposity Index: An alternative to BMI, which may more accurately reflect body fat content.
- **Total Body Water (TBW)** refers to the total amount of water present in a person's body, including the intracellular (inside cells) and extracellular (outside cells) compartments. Along with fat mass and lean mass, water content helps assess a person's overall fitness level and health.
- **Body Fat Percentage:** a measure of the proportion of fat in the body relative to total body weight. It is an essential indicator of body composition, and higher body fat percentages are linked to an increased risk of conditions like obesity, heart disease, and diabetes.

The ranges can vary depending on the population being studied or evaluated and the individual's health status, age, ethnicity, and activity level. The ranges representing general guidelines are (29):

Table 2: Anthropometric measures and significance

Measure	**Men**	**Women**	**Remarks**
Neck Circumference	> 37 cm	> 34 cm	Associated with higher cardiometabolic risk; varies by population.(30)
Waist Circumference	> 102 cm (40 in)	> 88 cm (35 in)	Indicator of abdominal obesity; part of the metabolic syndrome criteria.(31)
Hip Circumference	90–110 cm (general)	95–115 cm (general)	Used in waist-to-hip ratio calculations; may vary widely. (32)

Mid-Thigh Circumference	47–55 cm (general)	43–53 cm (general)	Indicates muscle and fat distribution in the lower body; sound in sarcopenia and obesity studies. (33)
Maximum Calf Circumference	> 34 cm	> 33 cm	Larger values often correlate with lower mortality in older adults. (34)
Triceps Skinfold Thickness	12.5 mm–15 mm	16.5 mm–18 mm	Used to estimate body fat percentage; reference values may differ based on age and ethnicity. (35)
Waist-to-Hip Ratio (WHR)	> 0.90	> 0.85	WHR > cutoff values indicate an increased risk of cardiovascular disease. (36)
Waist-to-Stature Ratio (WSR)	> 0.5	> 0.5	Waist circumference should be less than half height; >0.5 indicates increased health risk. (37,38)
Body Adiposity Index (BAI)	> 25%	> 30%	Based on hip circumference and height, BAI > 25% for men and > 30% for women indicates excess body fat.(39,40)

Table 3: Classification based on BMI

CLASSIFICATION	**WHO**(41)	**ASIA-PACIFIC**(42)
Underweight	<18.5	<18.5
Normal range	18.5-24.9	18.5-22.9
Overweight	25-29.9	23-24.9
Obesity class/grade 1	30-34.9	25-30
Obesity class/grade 2	35-39.9	>30
Obesity class 3	>40	-

Hyperglycemia

Diabetes: Diagnosed by A1C criteria or plasma glucose criteria, either the fasting plasma glucose (FPG) value, 2-h glucose (2-h PG) value during a 75-g oral glucose tolerance test (OGTT), or random glucose value accompanied by classic hyperglycemic symptoms or hyperglycemic crises.

Classic symptoms of Hyperglycemia: Polyuria, polydipsia, and unexplained weight loss

Hyperglycemic crisis: Diabetic ketoacidosis (DKA), Hyperosmolar hyperglycemic state (HHS) (43)

Prediabetes: Presence of IFG and/or IGT and/or A1C 5.7–6.4%

WHO defined Impaired Fasting Glucose **(IFG)** as Fasting plasma glucose(FPG) within the range of 110-125mg/dl(6.1-6.9mmol/L). Impaired glucose intolerance is the same as the ADA definition. (44)

Table 4: ADA Hyperglycemia definitions:

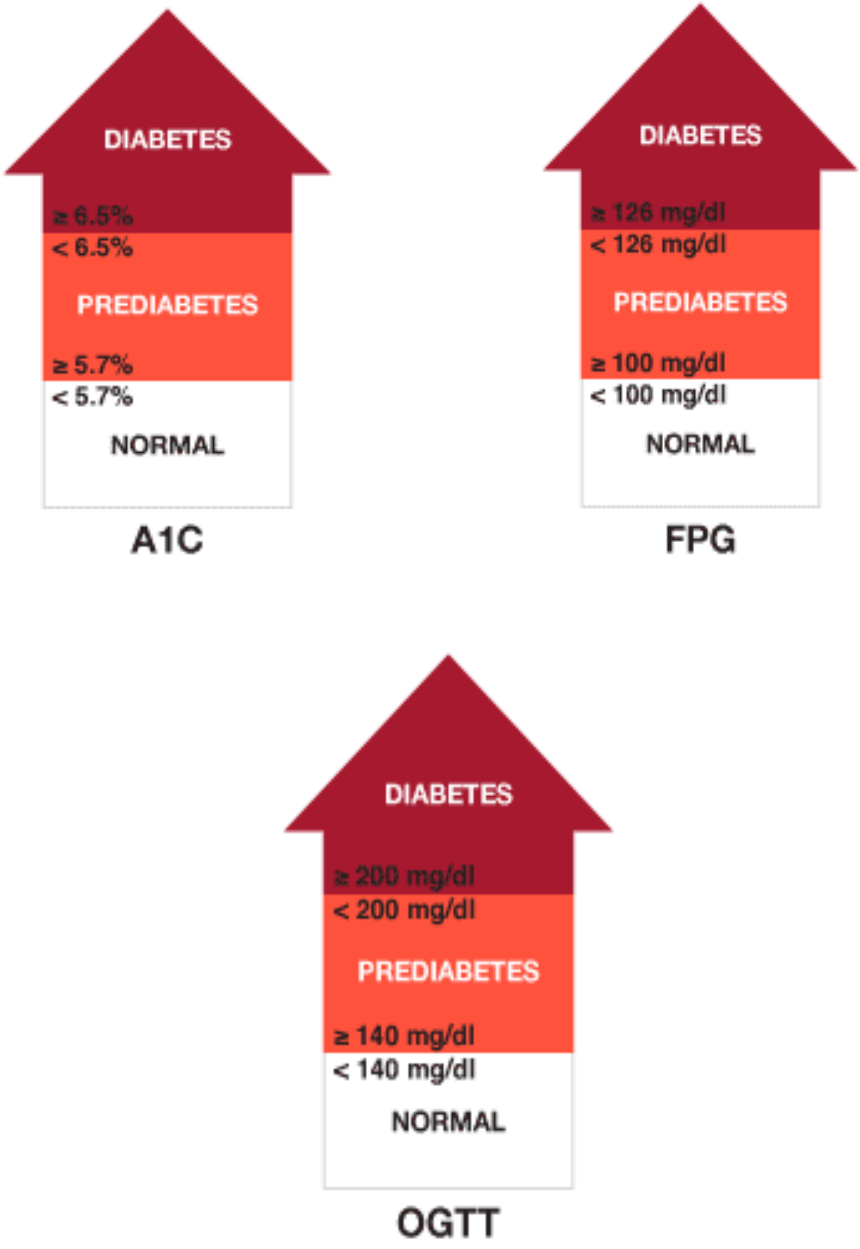
Result	**A1C**	**Fasting Plasma Glucose (FPG)**	**Oral Glucose Tolerance Test (OGTT)**	**Random plasma glucose**
Normal	< 5.7%	< 100 mg/dL	< 140 mg/dL	
Prediabetes	5.7% to 6.4%	100 to 125 mg/dL (5.6-6.9mmol/L): **IFG**	140 to 199 mg/dL (7.8-11.0 mmol/L): **IGT**	
Diabetes	6.5% or higher	126 mg/dL (7.0 mmol/L) or higher	200 mg/dL (11.1 mmol/L) or higher	200 mg/dL (11.1 mmol/L) or higher with classic symptoms of hyperglycemia or hyperglycemic crisis (45)

Fasting: No calorie intake for at least 8 hours

OGTT: Glucose load containing 75 gm anhydrous glucose is dissolved in water. Fasting or carbohydrate restriction can falsely elevate glucose levels with an OGTT. Hence, people should consume a mixed diet with at least 150 g of carbohydrates on the three days before OGTT.

Random: Any time of day, regardless of meal

Figure 2: Hyperglycemia spectrum



Detection rates of different screening tests vary in populations and individuals. The differences in diagnostic use of the tests are –

- **A1c** offers a long-term average (over 2-3 months, reflecting chronicity of hyperglycemia) and doesn't require fasting, but it may be less sensitive to rapid changes in blood glucose. There is an altered relationship between A1C and glycemia in conditions such as some hemoglobin variants, thalassemia or folate deficiency, anemia, pregnancy (second and third trimesters and the postpartum period), G6PD deficiency, recent blood loss or transfusion, HIV, hemodialysis, or erythropoietin therapy, plasma glucose criteria should be used to diagnose diabetes. In the sickle cell trait, an A1C assay can be used (as RBC turnover is average).(45–48)

- **FPG** is a simple test for immediate blood sugar levels but requires an overnight fast. Some individuals may find it difficult to fast for the required 8 hours or may misreport their fasting status.

FPG (or A1C) is typically preferred for routine screening due to the ease of administration.

- **OGTT** is the most sensitive for diagnosing prediabetes or early diabetes, especially impaired glucose tolerance, but it is more time-consuming and complex and requires preparation and timed blood draws.

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The disadvantages of glucose screening tests:

- **High diurnal variation**: Glucose levels fluctuate throughout the day, affecting accuracy.
- **External factors**: Recent physical activity, illness, or acute stress can alter glucose levels, impacting results.
- **Glycolysis issue**: Glucose levels can drop if blood samples are not processed or stored properly due to ongoing glycolysis.

Diabetes Symptoms: In type 2 diabetes, hyperglycemia leads to osmotic symptoms like polyuria (excessive urination) and polydipsia (excessive thirst). The body struggles with insulin resistance or insufficient insulin production, causing glucose buildup in the blood. The kidneys try to remove excess glucose through urine, resulting in frequent urination, which triggers thirst to replenish lost fluids. In type 1 diabetes, weight loss occurs despite increased appetite (polyphagia). The body cannot use glucose for energy due to a lack of insulin, leading to fat and protein breakdown for fuel, causing weight loss despite food intake. Recurrent urogenital infections are also common in both types due to high blood sugar levels that weaken the immune system and create a favorable environment for infections, particularly in the urinary tract.

Confirming Diagnosis of Diabetes (ADA Guidelines 2024):

1. **Clear clinical diagnosis**: If a person has classic hyperglycemia symptoms or a hyperglycemic crisis with a **random plasma glucose ≥200 mg/dL (≥11.1 mmol/L)**, a single test can confirm diabetes.
2. **Two abnormal test results**: In the absence of a precise diagnosis, diabetes should be confirmed with **two abnormal screening test results**:
    - Both results can be from the same test (e.g., A1c) done simultaneously or at two different time points.
    - The second test should be performed promptly if different from the initial test.
3. **Example of confirming diagnosis**:
    - If an A1c result is **7.0%** and a repeat result is **6.8%**, diabetes is confirmed.
    - If both different tests (A1c and FPG) are above diagnostic thresholds, the diagnosis is also confirmed.
4. **Discordant results**: If tests produce conflicting results, repeat the one above the diagnostic threshold. Factors affecting test accuracy (e.g., conditions affecting

A1c or glucose) should be considered. Diagnosis is based on the **confirmatory test**.

5. **Test near threshold**: If test results are near diagnostic thresholds, healthcare providers should educate individuals about possible hyperglycemic symptoms and **repeat testing in 3–6 months**.
6. **Substantial discordance**: Large differences between A1c and glucose test results require follow-up to explore underlying causes. Other biomarkers like fructosamine or glycated albumin should be considered for monitoring chronic hyperglycemia.

Criteria for screening for diabetes or prediabetes in asymptomatic adults

1. **Adults with Overweight or Obesity:** Screening should be considered for adults with a BMI of ≥25 kg/m², or ≥23 kg/m² for Asian Americans, who also have one or more of the following risk factors:

- A first-degree relative with diabetes
- High-risk race or ethnicity (such as African American, Latino, Native American, Asian American, or Pacific Islander)
- History of cardiovascular disease (CVD)
- Hypertension (BP ≥130/80 mmHg or on antihypertensive therapy)
- Low HDL cholesterol (<35 mg/dL or <0.9 mmol/L) and/or elevated triglycerides (>250 mg/dL or >2.8 mmol/L)
- Polycystic Ovary Syndrome (PCOS)
- Physical inactivity
- Other insulin resistance-associated conditions (e.g., severe obesity, acanthosis nigricans)

2. **People with Prediabetes:** Individuals with an A1C ≥5.7% (≥39 mmol/mol), impaired glucose tolerance (IGT), or impaired fasting glucose (IFG) should be screened annually.

3. **History of Gestational Diabetes Mellitus (GDM):** Individuals with a history of GDM should undergo lifelong screening, with testing at least every three years.

4. **General Screening:** For all other adults, screening should commence at age 35.

5. **Normal Results:** If initial results are within normal limits, retesting should occur at least every three years.

6. **Additional High-Risk Populations:** Screening is also recommended for people with HIV, a history of pancreatitis, or those on high-risk medications (such as glucocorticoids, statins, thiazide diuretics, HIV medications, or second-generation antipsychotics).

Follow-up Recommendations for Prediabetes and Diabetes

1. Patients with Prediabetes:

- Testing Frequency: Annual monitoring is recommended to detect progression to diabetes.
- Lifestyle Interventions: Encourage weight loss, dietary modifications, and physical activity to reduce diabetes risk.
- Medications: In some high-risk cases (e.g., BMI ≥35, age <60, prior gestational diabetes), metformin may be considered to prevent progression.

2. Patients with Diabetes:

- A1c Testing: Test every six months for stable patients meeting treatment goals. For patients not meeting goals or who have had therapy changes, Test every three months.
- Blood Glucose Testing: For patients on insulin: Encourage self-monitoring multiple times a day, especially before meals and bedtime.
- Continuous Glucose Monitoring (CGM): Recommended for patients on intensive insulin therapy or those with frequent hypoglycemia or glycemic variability.

3. Comprehensive Management:

- Blood Pressure & Lipid Monitoring: Regular monitoring reduces cardiovascular risks.
- Annual Screening: Check for complications (e.g., retinopathy, nephropathy, neuropathy) and manage risk factors proactively.

Dietary and lifestyle Recommendations according to the American Diabetes Association (ADA) 2024 Guidelines for managing prediabetes and diabetes:

1. Macronutrient Distribution: The ADA recommends tailoring macronutrient distribution based on individual preferences, metabolic goals, and dietary patterns.

- General Balance:
    - Carbohydrates: 45-55% of total daily calories (primarily from nutrient-dense, high-fiber foods).
    - Fats: 25-35% of total calories, focusing on healthy fats.
    - Proteins: 15-25% of total calories, with a focus on lean proteins.
- Meal Frequency: Eating smaller, more frequent meals can help stabilize blood sugar levels, especially in individuals who experience spikes after larger meals.

2. Carbohydrates: Emphasize whole, unprocessed carbohydrates such as whole grains, vegetables (especially non-starchy ones), fruits, legumes, and low-fat dairy, foods with a low glycemic index.

Fiber: Aim for 25-35g of dietary fiber per day, focusing on non-starchy vegetables, whole grains, legumes, and fruits to help control blood sugar and improve digestive health.

3. Fats: Prioritize healthy fats, such as:

    - Monounsaturated fats: Olive oil, avocados, nuts, seeds.

- Polyunsaturated fats: Fatty fish (like salmon), flaxseeds, walnuts.
- Limit saturated fat intake to less than 10% of daily calories (e.g. fatty meats, butter, and full-fat dairy)
- Avoid Trans Fats, typically found in hydrogenated oils and processed foods.

4. Protein

- Lean Proteins: Include lean meats, poultry, fish, eggs, legumes, tofu, and low-fat dairy.
- Increase consumption of plant-based proteins (e.g., legumes, nuts, seeds) with heart-health benefits.

6. Avoid sugary beverages and limit foods with added sugars. Use artificial or non-nutritive sweeteners as a sugar alternative (e.g., stevia, aspartame).

7. Limit Sodium: Aim for less than 2,300 mg/day; lower levels may be recommended for individuals with HTN.(49)

8. Alcohol Moderation: If alcohol is consumed, it should be in moderation—up to 1 drink/day for women and 2 drinks/day for men.

9. Mediterranean, DASH, and Plant-Based Diets: strongly recommended for managing diabetes and cardiovascular health:

- Mediterranean Diet: Rich in healthy fats, vegetables, legumes, whole grains, fish, and nuts.
- DASH Diet: Emphasizes fruits, vegetables, and low-fat dairy and limits salt and saturated fat.
- Plant-Based Diet: Encourages whole, minimally processed plant foods (vegetables, fruits, legumes, nuts) and limits animal products.

10. Physical Activity

- Aim for 150 minutes per week of moderate-to-vigorous-intensity aerobic exercise (e.g., brisk walking, cycling, swimming), spread over at least 3 days per week, with no more than 2 consecutive days without activity.

- Include resistance exercises (e.g., weightlifting, bodyweight exercises) 2-3 times per week, targeting major muscle groups.
- Incorporate flexibility and balance exercises (e.g., yoga, tai chi) at least 2-3 times per week.
- Reduce prolonged sitting and break up sedentary time by standing, walking, or light activity every 30 minutes.

11. Weight loss and Sustained Weight Maintenance:
    - For those with prediabetes or Type 2 diabetes, weight loss is a key component of management. The ADA recommends a goal of 5-10% weight loss for overweight or obese individuals,

12. Smoking Cessation

13. Aim for 7-9 hours of sleep per night.

Table 5: Glycemic recommendations for nonpregnant adults with diabetes

A1C	<7.0% (<53 mmol/mol)
Preprandial capillary plasma glucose	80–130 mg/dL (4.4–7.2 mmol/L)
Peak postprandial capillary plasma glucose (1-2 hr after beginning the meal)	<180 mg/dL (<10.0 mmol/L)

Diabetes mellitus and thyroid disease association

Studies have shown a higher prevalence of thyroid dysfunction in individuals with both type 1 and type 2 diabetes compared to those without diabetes. The connection between type 1 diabetes and autoimmune thyroid diseases can be explained by autoimmunity, and this combination is classified as an autoimmune polyglandular syndrome type 3 variant, according to the Neufeld and Blizzard classification. In contrast, the relationship between

thyroid function and glucose intolerance or type 2 diabetes mellitus is more complex. Both hyperthyroidism and hypothyroidism are potential risk factors for glucose intolerance. Additionally, thyrotoxicosis is more frequently observed in individuals with type 2 diabetes than in the general population. (50–52)

Thyroid dysfunction leading to hyperglycemia?

A 2019 study established a mouse model for spontaneous hypertension (SH) and tested it using an oral glucose tolerance test (OGTT) and an insulin tolerance test (ITT). The SH mice demonstrated impaired glucose and insulin tolerance, increased HOMA-IR levels, and decreased ISI indexes, all pointing to insulin resistance (IR). Additionally, the SH mice exhibited elevated levels of hepatic ERp29 and Bip, along with significant induction of the IRE1α and XBP-1s proteins, indicating endoplasmic reticulum (ER) stress, especially through the IRE1α/XBP-1 pathway. Treatment with 4-phenyl butyric acid alleviated ER stress, improving glucose metabolism and IR in SH mice. However, the exact mechanisms by which ER stress, particularly the IRE1α/XBP-1 pathway, regulates glucose metabolism and insulin resistance still require further investigation.(53)

Thyroid Hormone and Metabolism

Thyroid hormone (TH) is critical in development and adult metabolism regulation. The two primary thyroid hormone receptor (TR) isoforms, TRα and TRβ, are expressed differently across tissues, each contributing uniquely to TH signaling. The conversion of thyroxine (T4) to the active form, triiodothyronine (T3), via type 2 deiodinase (D2) is a critical regulatory mechanism of metabolism, especially in the hypothalamus, white fat, brown adipose tissue (BAT), and skeletal muscle. Thyroid function is primarily regulated by thyrotropin-releasing hormone (TRH) and thyroid-stimulating hormone (TSH), but it also responds to nutritional signals like leptin and peptides regulating appetite. TH plays a vital role in metabolic regulation, affecting cholesterol and carbohydrate metabolism by interacting with other nuclear receptors like PPAR and LXR. The modulation of hepatic insulin sensitivity by TH, particularly in reducing gluconeogenesis, presents a potential therapeutic target for metabolic disorders.(53)

Pancreas and Thyroid Hormone

Thyroid hormone is crucial for the maturation and function of pancreatic β-cells. T3 is necessary for transforming immature pancreatic cells into glucose-responsive insulin-secreting cells. Both TRα and TRβ are expressed in pancreatic cells, and T3-TR complexes bind to the promoter of the transcription factor Mafa, leading to its activation. Despite studies showing T3's positive effects on β-cell function, high doses of thyroid hormones can lead to glucose intolerance. Additionally, thyroid hormone inactivation via deiodinase D3 is critical for normal β-cell development. Both hypothyroidism and hyperthyroidism affect insulin secretion, with hypothyroidism decreasing insulin production and hyperthyroidism increasing β-cell responsiveness and insulin clearance. (54,55)

Liver and Thyroid Hormone Regulation

Thyroid hormones regulate liver function by modulating the metabolic rate of hepatocytes while the liver metabolizes THs, maintaining systemic endocrine effects. The liver expresses all three deiodinases, with D1 playing a significant role in maintaining T3 homeostasis and rT3 clearance. Mouse models indicate that D2 also mediates intracellular T3 levels, particularly influencing susceptibility to obesity and liver steatosis. Additionally, D3 reactivation occurs in pathological conditions like liver tumors and critical illnesses. In the liver, thyroid hormones enhance gluconeogenesis and glycogenolysis, leading to hyperinsulinemia, glucose intolerance, and peripheral insulin resistance.(56,57)

Gastrointestinal Tract and Thyroid Hormones

Excess thyroid hormone can cause oxyhyperglycemia by increasing gastrointestinal motility and glucose absorption. T3 enhances Na+/glucose cotransporter (SGLT)-1 activity in enterocyte-like cells, although the overall protein levels of SGLT-1 remain unchanged. This enhancement is thought to result from increased Na+-K+ ATPase activity, which impacts Na+ flux and glucose absorption.(58)

Hypothalamic Integration of Thyroid Hormone

Thyroid hormone signals are integrated in the hypothalamus to regulate energy balance, particularly via the melanocortin system. This system includes pro-opiomelanocortin (POMC)-expressing neurons, neuropeptide Y (NPY), and agouti-related peptide (AgRP)-expressing neurons, which regulate appetite and feeding behaviors. Local T3 levels in the hypothalamus fluctuate with metabolic conditions, such as fasting, influencing orexigenic and anorexigenic pathways. Deiodinases, particularly D2, play a key role in managing central TH levels and energy expenditure in response to changes in metabolic status.(59,60)

Skeletal Muscle and Thyroid Hormone Interaction

In skeletal muscle, thyroid hormones regulate glucose transport and fatty acid oxidation. Key genes such as GLUT4 and UCP-3 are influenced by T3, promoting both basal and insulin-induced glucose transport. Additionally, D2 expression in skeletal muscle is crucial for muscle regeneration and differentiation. TH signaling in muscle is linked to insulin sensitivity, and polymorphisms in the DIO2 gene have been associated with insulin resistance and diabetes. The response of muscle fibers to cold is also regulated by thyroid hormone, influencing glucose uptake and mitochondrial biogenesis.(61)

Lipid Metabolism and Thyroid Hormones

Thyroid hormones influence lipid metabolism by promoting lipolysis and fatty acid uptake while enhancing hepatic lipogenesis. Hypothyroidism is associated with hypercholesterolemia and increased LDL-C levels due to decreased clearance. Elevated serum-free fatty acids caused by thyroid hormones can contribute to insulin resistance.

Brown and White Adipose Tissue

In brown adipose tissue (BAT), thyroid hormones regulate energy expenditure, especially D2-mediated T4-to-T3 conversion. T3 accelerates fatty acid oxidation and lipogenesis, while loss of D2 function reduces thermogenic gene expression. In white adipose tissue (WAT), all TR isoforms are expressed, and deiodinases influence adipocyte

differentiation and lipogenesis. D1 expression is higher in obese individuals, and caloric restriction lowers D1 activity and leptin levels. (62)

Given the vast spectrum of metabolic body functions regulated by the TH signal, the deiodinases represent a powerful tool with which to modulate cellular metabolism in specific tissues without perturbing systemic levels of THs.(62)

Table 6: Effects of Thyroid hormone on glucose metabolism

Organ	**Effects on Glucose metabolism**
Gastrointestinal tract	Increase of mobility of gastrointestinal tract, Increased absorption of glucose Postprandial hyperglycemia in Hyperthyroidism
Liver	Increase of PEPCK activity, increased expression of the GLUT2 glucose transporter on hepatocyte Increase of gluconeogenesis
Adipose tissue	Increase of lipolysis, elevation of serum-free fatty acid
Skeletal muscle	Increase of GLUT4, increase of glucose uptake
Pancreatic beta cells	Inhibition of apoptosis, activation of growth and differentiation Increase in insulin secretion
Pancreatic alpha cells	Increase in glucagon secretion

Via sum of these effects on glucose metabolism by thyroid hormone, excess thyroid hormone will deteriorate glucose metabolism and cause glucose intolerance or diabetes mellitus. (58)

Hypothyroidism is a risk factor for metabolic syndrome. Excess and lack of thyroid hormone causes insulin resistance and glucose intolerance, and treatment of hypothyroidism was reported to improve insulin sensitivity. A recent meta-analysis revealed that patients with type 2 diabetes mellitus were associated with a 1.93-fold increase in the risk of SH compared to non-diabetics. Moreover, diabetic complications were more prevalent in patients with both type 2 diabetes mellitus and SH than those with type 2 diabetes mellitus of normal thyroid functions, including diabetic nephropathy, diabetic retinopathy, diabetic peripheral neuropathy, and peripheral arterial disease. The precise mechanism of aggravating the effect of subclinical hypothyroidism on diabetic complications is not fully clarified. Patients with subclinical hypothyroidism may have decreased cardiac output, renal flow, glomerular filtration, and increased vascular resistance, which may lead to diabetic nephropathy in patients with subclinical hypothyroidism. For diabetic retinopathy, thyroid hormone is also important for the development of the retina, as hypothyroid rats have smaller and thinner retinas. In terms of macrovascular complications, patients with hypothyroidism have been reported higher incidence of dyslipidemia and increased intima-media thickness, increased vascular stiffness, endothelial dysfunction, and hypercoagulability. All of these factors could contribute to the higher prevalence of peripheral arterial disease in diabetic patients with subclinical hypothyroidism.(63,64)

Diabetes leading to thyroid dysfunction?

In type 2 diabetes (T2DM), factors such as older age, obesity, female sex, hospitalization, and positive thyroid peroxidase antibodies increase the risk of developing hypothyroidism. Diabetes affects thyroid function by altering thyroid-stimulating hormone (TSH) levels and disrupting the conversion of thyroxine (T4) to triiodothyronine (T3). In euthyroid diabetic patients, TSH regulation can be impaired, particularly at night, and long-term hyperglycemia can worsen thyroid dysfunction. Diabetic ketoacidosis can cause a drop in T3 and T4 levels while keeping TSH levels normal. Hyperinsulinemia and insulin resistance also promote thyroid tissue proliferation, increasing the prevalence of goiter and nodules, with a higher risk of dysthyroid optic neuropathy in diabetic patients with goiter orbitopathy. Studies show older T2DM females are more prone to subclinical

hypothyroidism. For instance, a study in India found that T2DM patients over 65, especially females and the obese, have a significantly higher risk of hypothyroidism, with BMI, gender, age, and sex hormones contributing to thyroid dysfunction in T2DM. A review of 36 studies concluded that T2DM females over the age of 60 have a greater prevalence of subclinical hypothyroidism. Furthermore, in India, a cross-sectional observational study observed 1,508 T2DM patients. They discovered a significantly elevated risk of hypothyroidism in older type 2 diabetic patients (more than 65 years) with an OR of 4.2 and a clear difference between females and males (OR 4.82 vs. 2.60), as well as between obese and normal patients (OR 2.56 vs. 3.11). (65,66)

Hyperglycemia, in turn, can impact thyroid function by altering TSH levels and hindering the peripheral conversion of thyroxine (T4) to triiodothyronine (T3). There is also a link between the duration of diabetes and the development of hypothyroidism, suggesting that prolonged hyperglycemia may contribute cumulatively to thyroid dysfunction. Additionally, inflammation may play a role in the pathogenesis of both thyroid disorders and diabetes. Elevated levels of inflammatory cytokines in individuals with diabetes could accelerate the progression of hypothyroidism. Studies indicate that thyroid dysfunction (whether hyper- or hypothyroidism) is associated with increased levels of TNF-α in tissues and systemic circulation. Notably, TNF-α levels correlate positively with insulin resistance and fasting blood glucose. Furthermore, elevated inflammatory markers due to thyroid dysfunction may contribute to the development of diabetes. Treating hypothyroidism has been shown to restore insulin sensitivity and normalize glucoregulatory hormone secretion.

Studies correlating hyperglycemia and thyroid dysfunction

Numerous cross-sectional and cohort studies have examined the coexistence of diabetes and thyroid disorders, with the prevalence of thyroid disease in diabetic patients ranging from 10.8% to 32.4%. In a study by **Radaideh et al.**, the prevalence of thyroid disease in diabetic patients was 12.5%, significantly higher than the 6.6% observed in a control

group of healthy individuals in Jordan. A systematic review and meta-analysis of multinational studies also found a higher prevalence of hypothyroidism in individuals with type 2 diabetes mellitus (T2DM) compared to non-diabetic participants. Most of these studies recruited participants from hospitals or clinics.(67)

A **Chinese study** aimed to assess the distribution of thyroid function disorders, including hyperthyroidism, subclinical hyperthyroidism, hypothyroidism, and subclinical hypothyroidism (SH), across various glucose tolerance statuses—T2DM, pre-diabetes (pre-DM), and normal glucose tolerance (NGT)—in adults. The findings revealed that SH was more prevalent in women than men across all glucose tolerance categories and increased with worsening glucose tolerance. Patients with SH had higher HOMA-IR values compared to those with normal thyroid function [2.44 (1.44, 3.93) vs. 2.12 (1.39, 3.26), P = 0.018], and a one-unit increase in insulin resistance (IR) was associated with a 7% higher risk of developing SH (OR = 1.07, 95% CI: 1.03–1.12).(1)

The **Suita study** was a cross-sectional study of 3,607 participants in a community health survey in Suita, Osaka, Japan. The study aimed to characterize subclinical thyroid dysfunction from cardiovascular and metabolic viewpoints. Participants were categorized into 5 groups: normal, hyperthyroidism, hypothyroidism, subclinical hypothyroidism, and subclinical hyperthyroidism. The study examined the association between each thyroid dysfunction group and various phenotypes related to cardiovascular disease and metabolic syndromes. The key finding was that subclinical hypothyroidism was not associated with most cardiovascular and metabolic factors, except for higher fasting blood glucose and glycol-hemoglobin A1c levels compared to euthyroidism.(68)

Pregnancy consideration

Drs. Aras and **Dincgez** tried to evaluate the associations between SH and pregnancy outcomes and determine whether the presence of thyroid autoantibodies (TPO Ab) will affect the pregnancy outcomes, regardless of the presence or absence of SH. The results showed that pregnant women with SH have a higher risk of developing impaired glucose

tolerance (IGT) in all cohorts than those without. The presence of TPO-Ab in SH further augmented its effect to increase the risk of the development of IGT with an odds ratio (OR) of 3.56 (95% CI 2.37, 5.34). By contrast, only the presence of TPO-Ab did not increase the risk of the development of IGT if those pregnant women did not have SH. (8,69)

Drugs causing thyroid dysfunction

Metformin has TSH-lowering action, while free thyroxin hormones are unaffected (may be due to inhibition of AMPK in the hypothalamus). Diabetic patients have been reported to have increased thyroid volume and a higher prevalence of thyroid nodules. Patients with metformin treatment had smaller thyroid volumes and lower thyroid nodule risk than controls.

PPAR-gamma agonist is an antidiabetic drug of insulin-sensitizing effects. The administration of TZD to patients with thyroid-associated orbitopathy has been reported to be associated with aggravation of the ophthalmopathy.

GLP-1 receptor agonists have been reported to activate rodent thyroid C-cells and cause calcitonin release and C-cell proliferation; they are currently contraindicated in patients with medullary thyroid cancer and in patients with multiple endocrine neoplasia type 2 (predisposed to medullary cancer).(29)

Amiodarone, lithium, interferon, antidopaminergics, bexarotene, corticosteroids, anti-CTLA4, and anti-PD-1, cause hypothyroidism.

Methimazole (antithyroid drug) is related to the development of insulin autoimmune syndrome.

Aim and Objectives

AIM

The aim of the current study is to determine the magnitude and predictors of subclinical hypothyroidism in patients with impaired glucose tolerance in newly diagnosed adults in OPD-based settings associated with AIIMS Bhopal.

OBJECTIVES

Primary Objectives

-To perform a clinical review of adults with Impaired Glucose Tolerance and to determine the proportion of Individuals who have co-existent Subclinical hypothyroidism.

-To determine if certain anthropometric risk factors (Body Mass Index, Waist Hip Ratio, Waist Circumference, BP, Body Composition analysis) of subclinical hypothyroidism and impaired glucose tolerance overlap.

Secondary Objective

-To determine change in HbA1c and TSH after six and 12 months of follow-up.

-To determine changes in anthropometric parameters of the participants after six and 12 months of prescribed therapies

Materials and Methods

Design and Ethics: We designed a **longitudinal study** in the urban slum community of Saibaba Nagar in Bhopal to answer our research question. The study design was approved by the Institute Ethics Committee for Student Research at AIIMS Bhopal. All study participants were administered a written informed consent, and only eligible and consenting individuals were included in the study. (LoP number AIIMS/BPL/IHECSR/July/22/PG/06 dated 23rd February 2023)

Setting: All India Institute of Medical Sciences Bhopal (AIIMSB) is a teaching medical institute located in Central India. The institute also runs community-based outreach services in low-income urban slum communities in the city of Bhopal. Primary Health care in the urban slums is delivered through Accredited Social Health Activists (ASHA) and Urban Primary Health Centers (UPHC). AIIMS Bhopal has been engaged in non-communicable disease (NCD) screening activities in urban slum areas since 2016-17. These screenings are performed by ASHA and include administration of home-based questionnaires, anthropometry, and screening capillary blood glucose (CBG) levels. ASHAs provide a listing of such home-based screening to the supervising social workers from AIIMS Bhopal for further action. Individuals who are at a higher NCD risk, such as those with suspected IGT, HTN, or DM, are advised to consult primary care physicians at UPHC. Primary care physicians usually follow the standard medical guidelines under the National Program for Prevention of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS) for decision-making.

Participants: We performed a two-step screening to identify participants for our study. In the first step, we obtained home-based screening lists as provided by the ASHA to identify individuals with a random CBG of 100mg/dL or more. All the individuals who screened positive in this first step were given an appointment to visit the UPHC on pre-specified days of the week in a fasting state. In the second step all such individuals were further evaluated with fasting CBG and a point-of-care HbA1c (SD Diagnostics, Seoul, South Korea) testing at UPHC.

Inclusion criteria: We included the following participants (age >18 years) who presented to OPD-based settings associated with AIIMS Bhopal in the current study:

a) Individuals who are detected to have IGT, with impaired fasting glucose (fasting CBG between 100-125mg/dL) and impaired HbA1c levels (5.7 and 6.4%).

Exclusion criteria: We excluded the following individuals from this study:

a) Individuals who were already receiving pharmacotherapy in the form of glucose-lowering medication.
b) Individuals with overt hypothyroidism or those who are already receiving any thyroid hormone modifying medications (such as thyroxine or anti-thyroid drugs) / Past history of thyroid disease.
c) Pregnant females
d) Individuals who have the following co-morbidities that limit their ability to engage in effective lifestyle measures:
    i. Chronic Kidney Disease (CKD)
    ii. Heart Failure with reduced ejection fraction (HFrEF)
    iii. Chronic Obstructive Airway Disease
    iv. Chronic Liver Disease
    v. Solid organ or hematological malignancies
e) Individuals with a concomitant steroid intake that can potentially modify their glycemic status.
f) Individuals who deny consent for participation in the study

Study Procedures:

a) Questionnaire Administration: Data on current symptoms, known comorbidities, and tobacco or alcohol use were collected from participants.

b) Clinical measurements:

i. Baseline Anthropometry: Measured height, weight, waist, hip, thigh, chest, and neck circumferences using a stadiometer, weighing scale, and non-stretchable tape.

ii. Body Composition Analysis:

- Total body water **(TBW)**

  For adult males: TBW=0.6×Body Weight (kg)

  For adult females: TBW=0.5×Body Weight (kg)

- Body **fat** percentage: U.S. Navy Body Fat Formula

  Men: Fat% =86.010×log10(Waist−Neck)−70.041×log10(Height)+36.76

  Women:

  Fat%

  =163.205×log10(Waist+Hip−Neck)−97.684×log10(Height)−78.387

iii. Blood Pressure Measurement: using a digital sphygmomanometer.

c) Sample collection and Testing:

i Blood glucose estimation by glucometer

ii. Collected 2mL venous blood samples from all participants for serum TSH and HbA1c assessment.

iii. Point-of-Care TSH Testing conducted using SD Diagnostics (Seoul, South Korea), with a 20-minute turn-around time. Point-of-care testing was chosen to avoid the need for serum sample storage and transportation. (Figure 3: SD Biosensor F2400 analyser)

d) Clinical Consultation:

i) Provided participants with a clinical consultation on the same day as the baseline assessment.

ii) Primary care physicians were briefed about the study and instructed to prescribe therapies per existing guidelines.

e) Follow-Up Protocol:

i) Participants were advised to follow up at 6 and 12 months at the UPHC for repeat anthropometry, HbA1c, and TSH testing.
ii) ASHA workers were instructed to conduct home-based follow-ups every three months.

Figure 3: SD Biosensor F2400 analyser

***Study outcomes*:** The key study outcome was glycemic and thyroid status on follow-up. We defined glycemic status as overt DM if follow up HbA1c level was more than 6.4%, and IGT if it was between 5.7 and 6.4%. Since the upper limits of serum TSH levels were generally 4.0-5.0 mIU/L in most facilities, we defined SH in our study as TSH range 5-10 mU/L. For feasibility outcomes, we recorded the refusals for intravenous blood sampling, failure events for obtaining an adequate sample, and equipment failure events. We estimated the ratio of the number of test kits used and reported tests to assess the efficiency of point-of-care TSH and HbA1c testing.

Statistical Analysis: We performed primary data collection in a standardized form and entered the data in MS Excel. Prior to data analysis, we performed a consistency check for all the key variables entered in the database. We estimated Body mass index (BMI), Waist-to-hip ratio (WHR), and waist-to-height ratio (WSR) as secondary variables from primary anthropometric variables (height, weight, waist circumference, and hip circumference). We performed a descriptive analysis and described the variables with respect to measures of central tendency and distribution (e.g., Mean (Standard deviation), Median (Range), and frequency (proportions)). We compared the distribution using a t-test for means, a Wilcoxon rank-sum test for medians, and a chi-square test for frequency. We performed baseline and end-line comparisons in the various anthropometric parameters in participant subgroups based on study outcomes. We also performed multivariable regression analysis to evaluate for independent predictors of SH amongst individuals with IGT. All statistical analysis was done using statistical software R.

Results

Between April and June 2023, a total of 960 individuals were screened by the ASHA in the urban slum areas, and of them 248 were referred to UPHC for the second screen. Amongst those who were referred for a second screen,173 satisfied the inclusion criteria as their glycemic parameters (FCG, and HbA1c levels) were in IGT range. Of them 148 were included, and remaining 25 were excluded (CKD, HFrEF, COAD, CLD, already taking treatment, not given consent).

At the follow-up (after 6 or 12 months), 123 participants remained in the study. A total of 20 were lost to follow-up, 4 withdrew consent, and 1 participant died.

Figure 4: Study Flow

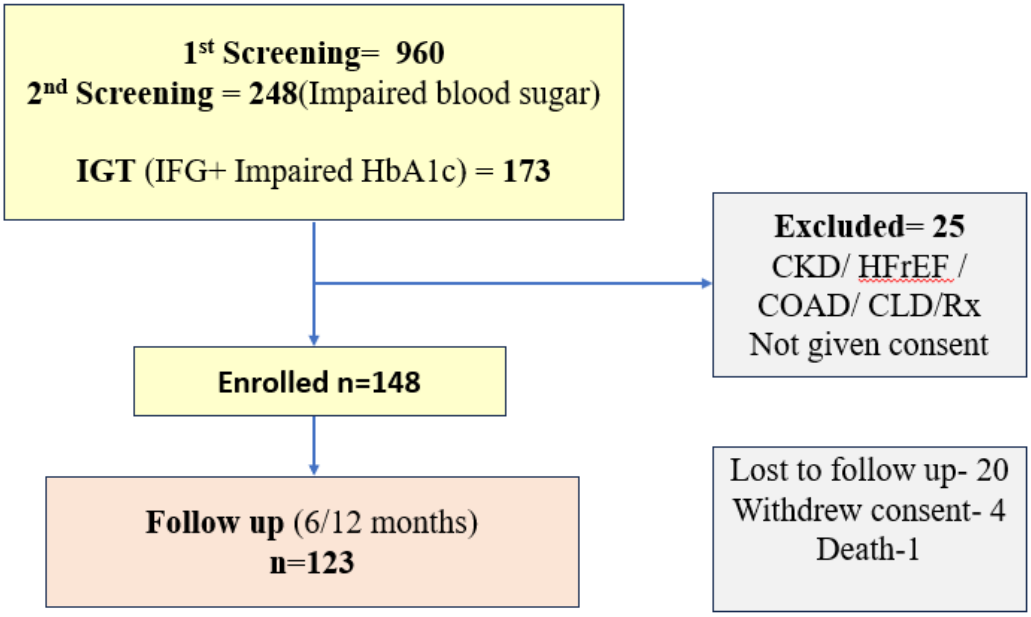


Table 7: Baseline Demographic characteristics (n=148)

Baseline Characteristic	Value
Mean Age (SD) years	47.8 (12.0)
Female Gender n (%)	85 (57.4%)
Any Addiction n (%)	26 (17.6%)
Tobacco use n (%)	22 (14.9%)
Years of Tobacco use (SD)	1.6 (4.7)
Alcohol Use n (%)	9 (6.1%)
Years of Alcohol use (SD)	0.5 (2.6)

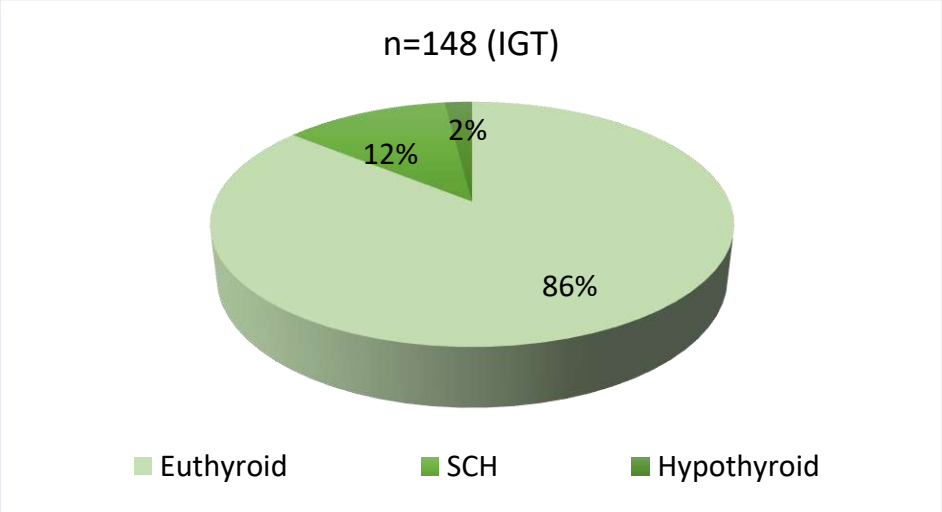
Table 7, with baseline demographic characteristics indicates that the included participants(n=148) were middle aged (mean age 47.8 (SD 12.0) years), and most of them were women (n=85 (57.4%)). Addiction behaviours were present in a smaller segment, with 17.6% reporting some form of addiction, including 14.9% who used tobacco and 6.1% who consumed alcohol. Among those who used tobacco, the average duration of use was 1.6 years, while alcohol users had been consuming alcohol for an average of 0.5 years. (table 7)

Table 8: Baseline Comorbidities (n=148)

Baseline Characteristic	Value
Hypertension n (%)	26 (17.6%)
Years of known hypertension (SD)	0.7 (1.8)
Mean Random capillary blood sugar mg/dL	127.6 (22.7)
Mean Fasting capillary blood sugar mg/dL	111.1 (8.6)
Baseline mean (SD) HbA1c %	6.0 (0.2)
Baseline mean (SD) TSH (µU/mL)	3.2 (2.1)

Table 8 for baseline comorbidities indicates that 17.6% (n=26) had a history of hypertension, with an average duration of 0.7 years (±1.8). The mean random capillary blood sugar level was 127.6 mg/dL (±22.7), while the mean fasting capillary blood sugar level was 111.1 mg/dL (±8.6). Baseline HbA1c of the participants was 6.0%, and TSH level was 3.2 µU/mL.

Figure 5: Thyroid abnormalities based on TSH screening in individuals with IGT (n=148)



Of the 148 individuals, 18 (12.2%) had TSH levels between 5 -10 µU/mL, and based on this TSH screen we classified them as having SH. Additional 3 (2%) individuals had a TSH level above 10 µU/mL. Remaining 127 (85.8%) were euthyroid. None of the screened individuals had TSH level of less than 0.5 µU/mL. (Figure 5)

Table 9: Distribution of baseline demographic factors across Thyroid dysfunction categories.

Characteristic	Euthyroid N = 127[1]	Thyroid dysfunction N = 21[1]	p-value[2]
Mean Age	47.5 (12.0)	49.7 (12.4)	0.422
Female Gender	71 (55.9%)	14 (66.7%)	0.356

The distribution of participants across euthyroid (n=127) and thyroid dysfunction (n=21) categories suggests a relatively balanced age and gender distribution with no significant difference. (Table 9)

Table 10: Distribution of baseline cardio-metabolic variables across Thyroid dysfunction categories.

Characteristic	**Euthyroid N = 127[1]**	**Thyroid dysfunction N = 21[1]**	**p-value[2]**
Known Hypertension	18 (14.2%)	8 (38.1%)	0.013
Mean HbA1c (%)	6.1 (0.2)	5.9 (0.2)	0.008
Mean SBP (mm Hg)	127.0 (15.5)	135.8 (22.9)	0.180
Mean DBP (mm Hg)	80.1 (9.0)	80.8 (11.0)	0.999
Mean Pulse (bpm)	81.7 (7.4)	82.3 (10.2)	0.891
Mean MAP (mm Hg)	95.7 (9.9)	99.1 (12.3)	0.458

The distribution of baseline cardio-metabolic variables between euthyroid individuals (n=127) and those with thyroid dysfunction (n=21) reveals several key differences. A significantly higher proportion of participants with thyroid dysfunction had known hypertension (38.1% vs. 14.2%, p=0.013).

Individuals with IGT who also had a TSH abnormality had significantly lower HbA1c levels as compared to those who were euthyroid (5.9% vs 6.1%). Other anthropometric measurements were similar between the two groups. Systolic blood pressure (SBP), Diastolic blood pressure (DBP), mean arterial pressure (MAP), and pulse rates were similar between the two groups, with no significant differences observed. (Table 10)

Table 11: Distribution of baseline anthropometric variables across Thyroid dysfunction categories.

Characteristic	Euthyroid N = 127[1]	Thyroid dysfunction N = 21[1]	p-value[2]
Mean Weight (Kg)	60.8 (13.7)	59.8 (8.9)	0.832
Mean Height (cm)	156.0 (7.1)	154.7 (6.0)	0.411
Mean BMI	25.0 (5.4)	25.0 (3.8)	0.526
Mean Waist Circumference (cm)	94.5 (13.8)	97.2 (12.1)	0.380
Mean Hip Circumference (cm)	93.1(10.0)	94.4 (11.0)	0.919
Mean WHR	1.015(0.116)	1.032 (0.094)	0.660
Mean WSR	0.607 (0.092)	0.630 (0.085)	0.274
Mean Thigh Circumference (cm)	41.8 (4.4)	41.4 (3.7)	0.753
Mean Chest Circumference (cm)	33.8 (3.4)	33.8 (3.2)	0.947
Mean Neck Circumference (cm)	33.6 (2.8)	33.1 (2.2)	0.410
Mean Total Body Water	36.5 (8.2)	35.9 (5.3)	0.832
Mean Fat Proportion	51.6 (16.5)	57.2 (16.2)	0.197
[1]Mean (SD); n (%)			
[2]Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test BMI=Body mass index; WHR=Waist to hip ratio; WSR=Waist to stature ratio; SBP=Systolic Blood pressure; DBP=Diastolic blood pressure; MAP = Mean arterial pressure			

Anthropometric measurements were similar across euthyroid (n=127) and thyroid dysfunction (n=21) categories. (Table 11)

Table 12: Distribution of treatments advised at baseline

Characteristic	**N = 148[1]**
Metformin	9 (6.1%)
OTHER	17 (11%)
Thyroxine	4 (2.7%)
Lifestyle modifications alone	148(100%)
[1]n (%)	

We adviced lifestyle modifications to all IGT patients (n=148). Out of 148, 9 were prescribed metformin depending on patients profile (including high BMI, IGT despite of having high physical activity or appropriate diet). Other treatments prescribed were antihypertensives mostly.

Table 13: Distribution of treatments at follow up

Characteristic	**N=123**
Metformin	9 (7.3%)
OTHER	13 (10.5%)
Thyroxine	2 (1.6%)
Life style modifications alone	99(80.5%)

Of all individuals included in the study, we could obtain a 6-month follow-up for 28 individuals (FU1) and 12-month follow-up for 118 individuals (FU2). Over all 123 participants had either a 6 month or a 12 month follow-up. We considered the last available follow-up values for all participants for further analysis. Of these 123 individuals, 99 (80.5%) received lifestyle therapy alone. Of the remaining 24 (19.5%) individuals, 9 were prescribed metformin, 13 were prescribed additional anti-HTN medication, and two had TSH levels greater than 10 µU/mL received low dose thyroxine. (table 12)

Table 14: Comparison of Baseline and 12 month follow up characteristics (n=123)

Characteristic	Baseline, N = 123[1]	Follow up N = 123[1]	Mean Difference (95% CI)[2]	p-value[2]
Fasting CBS (mg/dL)	127.6 (22.9)	118.6 (23.9)	9.0 (2.6, 15)	**0.006**
Mean HbA1c (%)	6.1 (0.2)	5.4 (0.7)	0.70 (0.56, 0.84)	**<0.001**
Mean TSH (µU/mL)	3.2 (1.8)	2.9 (2.3)	0.31 (-0.19, 0.81)	0.221
Mean BMI (kg/m2)	25.3 (5.5)	25.1 (5.4)	0.23(-0.20, 0.67)	0.292
Mean WHR	1.016 (0.114)	1.012 (0.104)	0.00(-0.01, 0.01)	0.447
Mean WSR	0.613 (0.093)	0.611 (0.091)	0.00(0.00, 0.01)	0.473
Mean Neck Circumference	33.6 (2.7)	33.5 (2.6)	0.05 (-0.28, 0.38)	0.764
Mean Chest Circumference	33.9 (3.4)	33.5 (3.0)	0.40(-0.05, 0.85)	0.081
Mean Thigh Circumference	41.9 (4.4)	41.1 (3.7)	0.80 (0.30, 1.3)	0.002
Mean SBP	128.5 (16.6)	129.6 (10.9)	-1.1(-4.2, 1.9)	0.457
Mean DBP	79.9 (9.0)	83.3 (7.3)	-3.4(-5.3, -1.5)	<0.001
Mean Pulse rate	82.1 (7.7)	82.3 (5.9)	-0.11(-1.8, 1.5)	0.897
Mean MAP	96.1 (9.9)	98.8 (7.3)	-2.7(-4.6, -0.76)	0.007

On follow-up as compared to baseline, there was a significant decline in mean HbA1c levels on follow up (Baseline 6.1% vs Follow up 5.4%; p<0.001). There was, however, no change in mean TSH levels (baseline 3.2 µU/mL vs Follow up 2.9 µU/mL; p=0.22). There was a reduction in fasting blood sugar value, but no other significant change was observed for other cardiometabolic and anthropometric measures. (Table 14)

Table 15: Change in Key variables amongst individuals who received Metformin and Lifestyle measures (n=123)

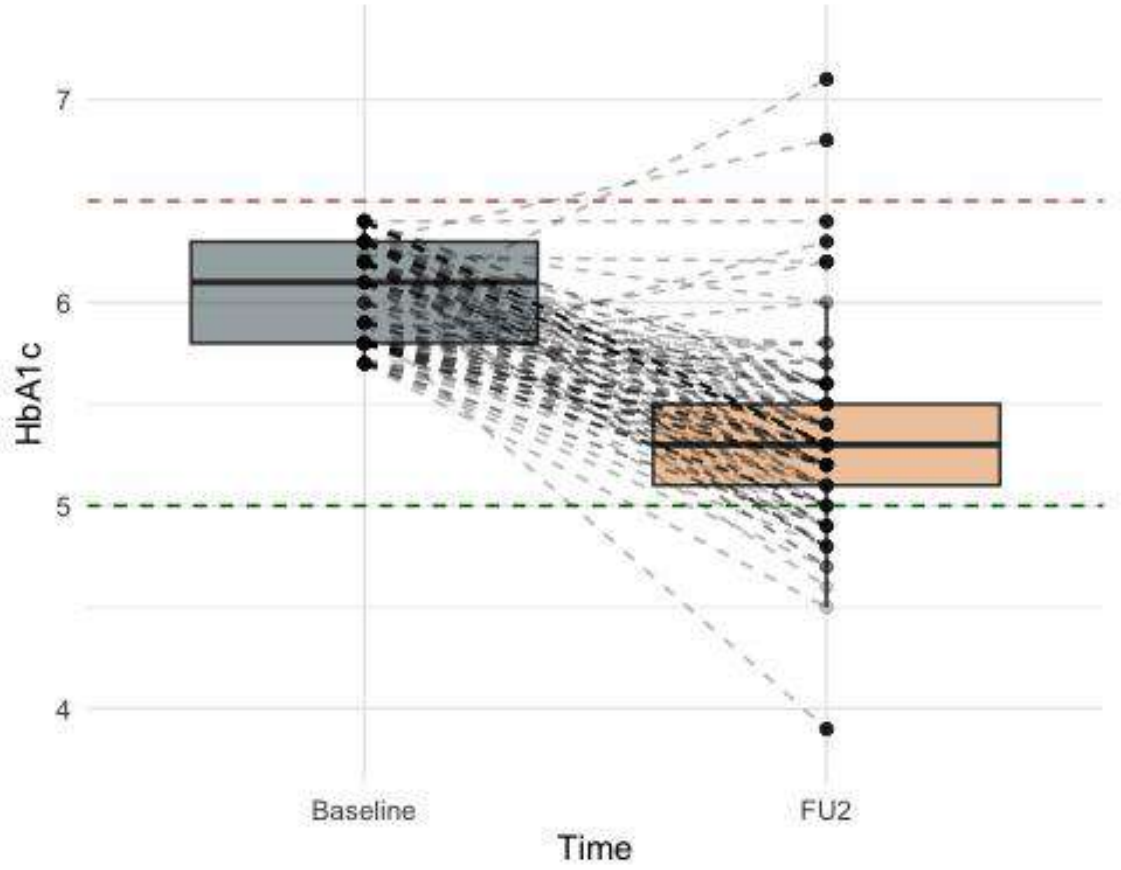
	Metformin + lifestyle measures (n=9)			
Characteristic	**Baseline**	**Follow up**	**Mean Diff. 95% CI**	**p-value**
Mean HbA1c (%)	6.3 (0.2)	5.4 (0.5)	0.83(0.31, 1.3)	**0.007**
Mean TSH (µU/mL)	2.4 (1.2)	3.0 (1.8)	-0.59 (-1.8, 0.58)	0.275
Mean BMI (kg/m2)	28.2 (7.2)	27.1 (7.1)	1.0 (-0.17, 2.3)	0.083
Mean WHR	1.020(0.090)	1.033 (0.074)	-0.01 (-0.03, 0.01)	0.164
Mean SBP (mm Hg)	131.6 (8.8)	135.2 (12.2)	-3.7 (-13, 5.6)	0.388
Mean DBP (mm Hg)	76.9 (8.5)	83.9 (5.0)	-7.0 (-14, 0.10)	0.053

Of the 123 individuals with IGT, 2 (1.6%) individuals had a rise in their follow-up HbA1c levels above 6.4% and were classified as new-onset DM. Most other individuals had a fall in their HbA1c values which was statistically significant (Mean difference 0.70 (95%CI 0.56, 0.84). The decline in mean HbA1c levels was seen in those who were prescribed Metformin, as well as those who were advised lifestyle interventions alone (Table 15,16, Figure 6)

Table 16: Change in Key variables amongst individuals who received Lifestyle measures alone (n=123)

	Lifestyle measures alone (n=114)			
Characteristic	**Baseline**	**Follow up**	**Mean Diff. 95% CI**	**p-value**
Mean HbA1c (%)	6.0 (0.2)	5.4 (0.8)	0.69 (0.54, 0.84)	**<0.001**
Mean TSH (μU/mL)	3.2 (1.8)	2.8 (2.3)	0.37 (-0.15,0.90)	0.164
Mean BMI (kg/m2)	25.1 (5.3)	24.9 (5.2)	0.17 (-0.30,0.63)	0.474
Mean WHR	1.016 (0.116)	1.010 (0.106)	0.01 (-0.01,0.02)	0.345
Mean SBP (mm Hg)	128.2 (17.0)	129.2 (10.7)	-0.95 (-4.2, 2.3)	0.564
Mean DBP (mm Hg)	80.1 (9.0)	83.3 (7.5)	-3.2 (-5.2, -1.2)	0.002

Figure 6: The trend in HbA1c values at baseline and on follow up (n=123)



This graph displays the changes in HbA1c (Hemoglobin A1c) levels over two time points: Baseline and FU2 (Follow-up 2).

Y-axis (HbA1c): Shows the percentage of HbA1c, a marker for long-term blood glucose control.

X-axis (Time): Represents two time points—Baseline (initial measurement) and FU2 (follow-up).

Boxplots: The boxes represent the interquartile range (IQR, 25th to 75th percentile), with lines (whiskers) showing variability. The central line inside the box is the median HbA1c value.

Dashed Lines: These connect individual patients' HbA1c levels from Baseline to FU2, illustrating the changes for each individual over time.

Outliers: Black dots outside the whiskers represent outlier HbA1c values.

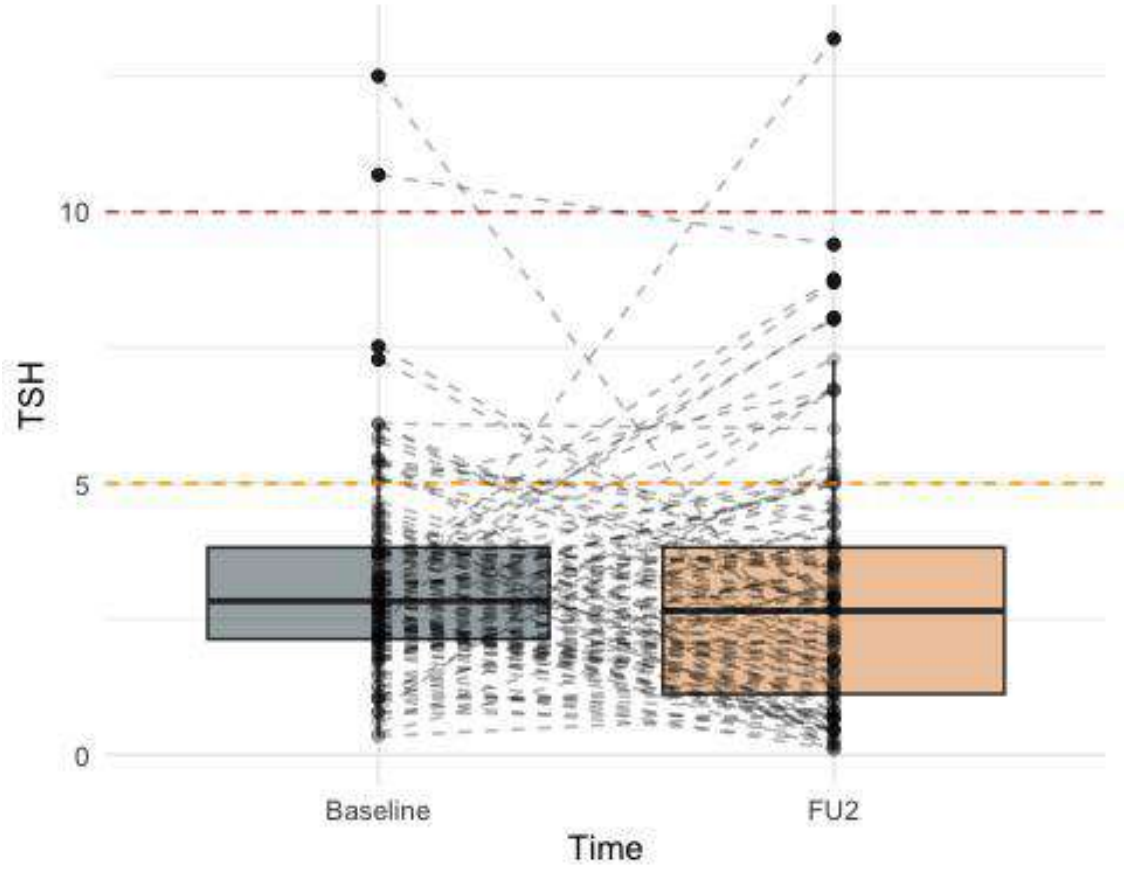
Threshold Lines: The red dashed line at HbA1c = 6.4% indicates the threshold for diabetes, and the green dashed line at HbA1c = 5.7% indicates a lower, healthier target.

The graph shows a general decrease in HbA1c levels from Baseline to FU2 for most individuals. At the Baseline, a greater proportion of patients had higher HbA1c levels, suggesting poorer glucose control. At FU2, the overall HbA1c levels appear to have improved, with more patients nearing the green dashed line, representing better glucose regulation.

The individual patient data (dashed lines) reveal that most patients experienced a decrease in HbA1c, indicating a positive response to the intervention or treatment being studied.

Of the 18 individuals, who had SH at baseline, follow up values were available for 16. Of these only 2 (12.5%) had a persistent SH. All the other 14 (87.5%) had their TSH values reverted to less than 5 µU/mL. None of these individuals were prescribed thyroxine. On the other hand of the 107 individuals who had their TSH levels below 5 µU/mL, 17(15.8%) had a rise in TSH to greater than 5 µU/mL on follow up. While, the overall prevalence of SH at baseline and follow up was similar (14.6% vs 15.4%), there was a significant bidirectional change in the TSH status. (Figure 7)

Figure 7: The trend in TSH values at baseline and on follow up (n=123)



This graph represents a boxplot showing the changes in TSH (Thyroid-Stimulating Hormone) levels over two time points: Baseline and FU2 (Follow-up 2):

Y-axis (TSH): Represents TSH levels in patients.

X-axis (Time): Two time points are Baseline (initial measurement) and FU2 (follow-up).

Boxplots: The boxes show the interquartile range (IQR, from 25th to 75th percentile), and the lines (whiskers) extend to show variability outside this range.

Dashed Lines: Each dashed line connects individual patient TSH levels between Baseline and FU2, illustrating the changes.

Outliers: The black dots represent TSH values outside the whiskers, indicating outliers.

Threshold Lines: The red dashed line at TSH = 10 and orange dashed line at TSH = 5 represent clinical thresholds for hypothyroidism (mild and overt, respectively).

The graph suggests some fluctuation in TSH levels over time, with individual patients showing either increases or decreases. At Baseline, more individuals seem to have higher TSH values compared to FU2, where TSH levels appear to have decreased slightly on average. The red and orange lines mark clinical significance, indicating a proportion of patients may still have elevated TSH levels post-follow-up.

In this study assessing TSH, fasting blood glucose, and HbA1c levels, several operational challenges were encountered. A notable proportion of participants refused intravenous blood sampling, which impacted the sample size and necessitated alternative methods to encourage compliance. There were also failure events in obtaining adequate blood samples due to poor venous access and participant movement, alongside sporadic equipment malfunctions that delayed the processing of samples. Some participants were not active health seekers, making it difficult to maintain regular follow-up and adherence to lifestyle modifications. Additionally, inconsistent fasting durations were observed, which introduced variability in fasting glucose results. Anthropometric measurements were subject to error, as some participants wore excessive clothing, while others reported recent weight loss due to illness or emotional stress, potentially confounding results. Furthermore, the non-specific nature of symptoms related to subclinical hypothyroidism complicated the clinical assessment. These challenges underscore the importance of careful planning and mitigation strategies in future studies of this nature.

Discussion

In the current study we found that amongst individuals with IGT, about 12.2 % of individuals had their TSH values in SH range. One year later, nearly 90% had their values reverted to normal without any specific thyroxine therapy. The conversion of TSH values from a euthyroid to SH range over one year was of similar magnitude. This suggests that SH is an unstable or transient metabolic state. Further, those individuals with abnormal TSH values had no adverse glycemic status. In fact, individuals with IGT who had a worsening of their glycemic status had an improvement in their TSH values. While measuring TSH values in a community-based setting was feasible, this additional screening does not seem to add value to overall clinical management.

Some studies explored various aspects of thyroid dysfunction, particularly subclinical hypothyroidism (SH), in different populations. **Fade et al.** studied 1,210 elderly patients, finding a higher prevalence of thyroid dysfunction in females, with 17.8% progressing to hypothyroidism over a 12-month period, supporting the recommendation for routine thyroid screening in those over 60 due to high dysfunction rate. **Li et al.** followed 505 Chinese patients with mild SH for three years, reporting that 43.8% had persistent SH and 49.7% reverted to normal; found that TPO antibodies and elevated cholesterol were key predictors of progression to overt hypothyroidism, while many patients reverted to normal thyroid function, suggesting the need for individualized monitoring of TSH and cholesterol levels in mild SH cases. **Rosario et al**., studying 241 patients, found that a TSH level above 8 mIU/L predicted the need for treatment, while lower TSH levels and absence of thyroiditis indicated a likelihood of reversion. **Somwaru et al.,** studying an elderly cohort, found that 56% of SH cases persisted over four years, with higher TSH levels (≥10) predicting progression. Across studies, TSH levels, TPO antibodies, and cholesterol were important predictors. Hence careful clinical analysis combined with markers such as TSH levels, thyroid antibodies (e.g., TPO antibodies), and ultrasonography, as highlighted in population-based cohort studies, can guide clinicians in deciding whether to treat subclinical hypothyroidism. In individuals over 60, diagnosing subclinical hypothyroidism becomes more challenging due to age-related increases in TSH levels, requiring a cautious interpretation of these values. Following up with thyroid antibodies and ultrasonography, which can detect autoimmune thyroiditis through hypo-echogenicity in the thyroid, significantly improves diagnostic accuracy in these cases. (106)

It is essential not to alarm the family when subclinical hypothyroidism is detected because this is a biochemical situation that normalizes in most cases. Thyroid hormone therapy was not associated with improvements in quality of life or thyroid-related symptoms in adults with subclinical hypothyroidism(107). This fact and the mean cost of specialized care suggest that the first step should be repeated TSH measurements in primary care.(108) According to the Royal College of Physicians, United Kingdom (RCP) (Vanderpump et al., 1996), screening for thyroid dysfunction is unjustified in the general population, but recommends screening in elderly females.(109)

In the treatment of subclinical hypothyroidism (SH) with levothyroxine (LT4), there is a risk of cardiovascular events due to overdosage. LT4 is generally not recommended for patients with serum TSH levels below 10 mIU/L unless symptoms of hypothyroidism are present. However, for patients under 70 years old with TSH levels between 7 and 10 mIU/L, LT4 may be considered depending on individual risk factors such as cardiovascular disease. LT4 supplementation is recommended for patients with TSH levels above 10 mIU/L but is typically avoided in patients over 70 unless specific conditions apply. The long-term benefits of LT4 on symptoms and cardiovascular outcomes in SH remain unproven, and guidelines, such as the 2019 British clinical practice recommendations, controversially advise against LT4 for most patients, except in certain cases like pregnancy or severe symptoms. In pregnancy, LT4 should be administered based on trimester-specific TSH levels, particularly in cases where anti-TPO antibodies are positive, or TSH exceeds 10 mIU/L.(54)

There is no correlation between thyroid function (measured by TSH and FT4) and physical activity levels in the general population. A meta-analysis involving 526 patients with metabolic obesity from 10 randomized controlled trials found that exercise had a moderate overall effect in reducing TSH levels compared to a control group. However, individual study analyses showed only a mild effect, with some studies indicating that training could negatively impact TSH levels. Despite this, exercise-based interventions are considered safe and effective for managing hypothyroidism and obesity-related to hypothyroidism. (56,110)

Guidelines and opinions on thyroid-stimulating hormone (TSH) screening and the management of subclinical hypothyroidism vary due to mixed evidence on the benefits of early detection in asymptomatic individuals. The American Thyroid Association recommends screening starting at age 35 with five-year intervals, especially for those at risk, while other organizations, like the American Academy of Family Physicians, advise screening after age 60. The U.S. Preventive Services Task Force (USPSTF) does not recommend routine screening, citing insufficient evidence and concerns about overdiagnosis and overtreatment, particularly for mild TSH elevation. In subclinical hypothyroidism, where TSH is elevated, but free thyroid hormone levels are normal, many cases remain stable or spontaneously resolve. However, treatment with levothyroxine is generally recommended for TSH levels above 10 mIU/L due to the increased risk of cardiovascular complications and progression to overt hypothyroidism. Evidence from studies on the benefits of treating subclinical hypothyroidism is mixed, with some suggesting cardiovascular benefits and others showing limited symptom improvement. Ultimately, most guidelines recommend an individualized approach based on patient risk factors rather than routine screening for all asymptomatic adults.

Table 17: Studies correlating hyperglycemia and thyroid dysfunction

Study	Study Population	Glucose-Related Disorder	Result	Significance/Conclusion	Statistics
Yang et al. (2010) China	1,152 subjects with normal and impaired glucose metabolism	IGT, Prediabetes	Higher prevalence of SH in IGT patients compared to normoglycemic individuals	Suggests a link between IGT/prediabetes and increased risk of SH	P <0.05
Roos et al. (2007) Netherlands	8,492 individuals	Prediabetes, Hyperglycemia	Subclinical hypothyroidism is associated with an increased risk of developing diabetes	Supports that thyroid dysfunction contributes to glucose metabolism abnormalities	HR 1.5; 95% CI 1.1–2.0; P =0.01

Dimitriadis et al. (2006) Greece	136 women (both euthyroid and hypothyroid)	Prediabetes	SH was more frequent in prediabetic women than in those with normal glucose levels	Indicates a significant association between SH and prediabetes in women	P <0.05
Rizos et al. (2011) Greece	1,416 subjects	Prediabetes, IGT	SH is more common in individuals with prediabetes and IGT	Highlights a potential bidirectional relationship between SH and glucose intolerance	OR 2.3; 95% CI 1.5–3.5; P <0.001
Anagnostis et al. (2014) Greece	1,500 postmenopausal women	Prediabetes, Hyperglycemia	Increased incidence of SH in women with impaired glucose levels	Suggests that postmenopausal women with glucose abnormalities may have a higher risk of SH	RR 1.7; 95% CI 1.2–2.4; P =0.003
He et al. (2012) China	3,500 participants	IGT	Positive correlation between elevated TSH levels and impaired glucose tolerance	Supports hypothesis that hypothyroidism may interfere with insulin sensitivity	Correlation coefficient 0.3; P <0.01
Pallotti et al. (2020) Italy	352 women with polycystic ovary syndrome (PCOS)	IGT, Prediabetes	Higher prevalence of SH in women with PCOS and glucose metabolism issues	Shows the interaction between SH and metabolic dysfunction in PCOS patients	P <0.05
Manolis et al. (2017) Greece	1,020 participants	Hyperglycemia	Positive association between subclinical hypothyroidism and hyperglycemia	Suggests SH may increase the risk of hyperglycemia or worsen glycemic control	OR 1.8; 95% CI 1.1–2.9; P =0.02

Marato u et al. (2009) Greece	98 participants	Prediabetes	SH individuals exhibited higher insulin resistance compared to controls	Indicates that SH may contribute to insulin resistance, potentially leading to prediabetes	P <0.05

Table 18: Indian studies correlating hyperglycemia and thyroid dysfunction

Study	Study Population	Glucose-Related Disorder	Result	Significance/Conclusion	Statistics
Udovcic et al. (2017)	560 Indian subjects with IGT	IGT, Prediabetes	Higher incidence of SH in individuals with prediabetes	Significant association between prediabetes and SH	OR 2.2; 95% CI 1.6–3.0; P <0.001
Mahato et al. (2011)	1,000 Indian adults, diabetic and non-diabetic	Hyperglycemia, IGT	SH was more frequent in subjects with IGT and hyperglycemia	Highlights that glucose abnormalities may increase the risk of SH	P < 0.05
Sinha et al. (2013)	852 individuals with thyroid disorders	IGT, Prediabetes	Prediabetic individuals had a significantly higher prevalence of SH compared to controls	Indicates a strong correlation between prediabetes and thyroid dysfunction	OR 1.9; 95% CI 1.4–2.6; P =0.002
Patel et al. (2015)	610 postmenopausal women	Prediabetes, Hyperglycemia	Higher prevalence of SH among postmenopausal women with prediabetes	Suggests that postmenopausal women with impaired glucose metabolism are at increased risk of SH	RR 1.6; 95% CI 1.3–2.2; P < 0.01
Jain et al. (2014)	400 type 2 diabetic patients	Diabetes, Hyperglycemia	Higher prevalence of SH in patients with poor glycemic control	Supports association between uncontrolled diabetes and SH	P < 0.05

Saxena et al. (2019)	1,200 individuals	Prediabetes, IGT	Significant association between subclinical hypothyroidism and impaired glucose tolerance	SH linked to increased risk of developing glucose metabolism disorders	HR 1.4; 95% CI 1.1–1.8; P = 0.01
Mishra et al. (2012)	900 individuals (diabetic and non-diabetic)	Prediabetes	Increased prevalence of SH in prediabetic and diabetic patients	Strong link between SH and glucose metabolism disorders	OR 2.5; 95% CI 1.9–3.3; P <0.001
Gupta et al. (2018)	560 women with polycystic ovary syndrome (PCOS)	Prediabetes, IGT	SH was more common in PCOS women with prediabetes	Suggests interplay between SH and glucose metabolism in PCOS patients	P < 0.05
Rana et al. (2020)	1,050 adults	IGT, Prediabetes	Higher SH prevalence in those with IGT and hyperglycemia	Strong association found between glucose abnormalities and SH	RR 1.7; 95% CI 1.4–2.3; P =0.001
Kapoor et al. (2016)	650 individuals with metabolic syndrome	Prediabetes	Significant correlation between SH and prediabetes	SH linked to metabolic dysfunction in individuals with metabolic syndrome	Correlation coefficient 0.25; P < 0.01

Many of the studies have found no significant correlation between SH and these early stages of glucose metabolism disorders as:

1. **Korean National Health and Nutrition Examination Survey (KNHANES) (2014)**: Population-based study analyzed the relationship between thyroid

function and metabolic syndrome components, including glucose tolerance. It found no significant difference in glucose tolerance status between individuals with SH and those with normal thyroid function.(75)

2. **Study by Yang et al. (2012)**: conducted on Chinese adults, no significant association was found between SH and impaired glucose metabolism or prediabetes(111).
3. A systemic review and meta analysis by **Lei Zhong** concluded that metabolic syndrome is associated with an increased risk of subclinical hypothyroidism, but the individual components of metabolic syndrome are not.(112)
4. A Meta-analysis of 21 studies by **Chaker et al.** (2016), suggested No significant association between SH and prediabetes in some populations (Pooled OR 1.1; 95% CI 0.9–1.3; P = 0.5)(113)

Summary

The study found that 12.2 % of individuals with impaired glucose tolerance (IGT) had subclinical hypothyroidism (SH), with nearly 90% of these individuals returning to normal thyroid function within a year without treatment, indicating that SH is often transient. SH did not worsen glycemic control, and those with worsening glucose levels saw improvements in TSH. The findings suggest that routine TSH screening in the community may not add value to clinical management. Additionally, other studies on subclinical hypothyroidism (SH) show varied progression rates, with factors like TSH levels, TPO antibodies, and cholesterol playing key roles in predicting outcomes. Guidelines on SH management differ, with levothyroxine treatment generally recommended only for TSH levels above 10 mIU/L, especially in younger individuals or those with cardiovascular risk. Routine thyroid screening is not universally endorsed, with most guidelines favoring individualized management based on patient risk factors rather than broad screening in asymptomatic adults.

The study exhibits several **strengths**, designed as a longitudinal study, which allowed for observing changes over time, providing insights into the dynamic relationship between impaired glucose tolerance (IGT) and subclinical hypothyroidism (SH). Conducted in the community, adding value to the study's external validity. Using ASHAs and UPHCs for initial screenings made the study more accessible to participants and ensured integration with existing healthcare services. Additionally, the two-step screening process using home-based listings and subsequent UPHC-based fasting glucose and HbA1c tests offered a robust mechanism for identifying participants with IGT. Another strength is the use of point-of-care testing for TSH and HbA1c, which had a short turnaround time, facilitating same-day clinical consultation and minimizing logistical barriers such as sample storage and transport. The study also incorporated detailed baseline anthropometric measurements, enhancing the depth of analysis. Ethical considerations, such as obtaining informed consent and excluding individuals with pre-existing diabetes or thyroid conditions, ensured the integrity of the study cohort. the study outcomes, including glycemic and thyroid status, were well-defined, and the statistical analysis was performed rigorously, with attention to both primary and secondary variables.

The study has some **limitations** that may have influenced the results. While the tests conducted were logistically feasible, they were not ideal for classifying impaired glucose

tolerance (IGT) or subclinical hypothyroidism (SH). For instance, oral glucose tolerance tests (OGTT) and T4, anti TPO antibody testing, which are essential for precisely classifying these conditions, were not performed. There was variability in the time intervals between initial and subsequent HbA1c and TSH measurements, which could have introduced bias into the findings. Furthermore, other key metabolic parameters, such as lipid profiles and liver function tests (AST/ALT), were not measured, limiting the comprehensive assessment of participants' metabolic health. The study population came from an urban slum area, predominantly of low socioeconomic status and physically active. Still, the impact of socioeconomic or demographic factors on lifestyle and health-seeking behavior was not thoroughly examined. Additionally, while a long-term study is necessary to understand the correlation between IGT and SH better, we were able to follow up with most participants only once, limiting the ability to observe long-term trends.

Conclusion

1. The baseline HbA1c of the participants was 6.0%, and the TSH level was 3.2 µU/mL. The included participants were middle-aged (mean age 47.8 (SD 12.0) years), and most of them were women (n=85 (57.4%)).
2. About 12.2% of individuals with impaired glucose tolerance (IGT) had baseline TSH values in the SH range.
3. One year later, nearly 90% of those with SH reverted to normal TSH values without specific thyroxine therapy, indicating SH as a transient or unstable condition.
4. Individuals with IGT who also had a TSH abnormality had significantly lower HbA1c levels as compared to those who were euthyroid (5.9% vs 6.1%). Other anthropometric measurements were similar between the two groups.
5. There was a significant decline in mean HbA1c levels on follow-up (Baseline 6.1% vs Follow up 5.4%; $p<0.001$).
6. One year later, nearly 90% of those with SH reverted to normal TSH values without specific thyroxine therapy, indicating SH as a transient or unstable condition.
7. A similar proportion of euthyroid individuals (15.8%) experienced a rise in TSH to the SH range over the one-year period, suggesting a dynamic fluctuation in TSH levels among the participants.
8. There was, however, no change in mean TSH levels on follow-up (baseline 3.2 µU/mL vs Follow up 2.9 µU/mL; $p=0.22$).
9. The overall prevalence of SH at baseline and follow-up was similar (14.6% vs 15.4%); there was a significant bidirectional change in the TSH status.

In conclusion, this study highlights that subclinical hypothyroidism (SH) is a transient condition among individuals with impaired glucose tolerance (IGT). Interestingly, the majority of these individuals reverted to normal thyroid function after one year without requiring thyroid hormone therapy, underscoring the unstable nature of SH. The study found no adverse glycemic impact among individuals with thyroid dysfunction; in fact, those with abnormal TSH values had slightly better glycemic outcomes. Although screening for thyroid dysfunction in a community setting was feasible, the results suggest that such screening may not significantly influence clinical management without specific

symptoms. This aligns with broader literature indicating that routine treatment of mild SH may not offer substantial benefits in most cases, particularly in populations without cardiovascular risk factors. Therefore, an individualized approach to thyroid screening and management, particularly in asymptomatic individuals, remains the most prudent course of action.

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Annexures

Annexure 1

DATA COLLECTION FORM

Data collection sheet (Baseline form)					Date ____ / _____ / _____
Section 1: Demographic Details					
Name				ID number	
CR #		Age (Yrs)		Address	
Occupation		Gender	M / F		
Mobile	#1	#2		Marital	Marr / Unmarr / Div / Wid
Section 2: Comorbidities					
HTN	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
Dyslipidemia	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
Obesity	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
Diabetes	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
Thyroid	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
Angina / IHD	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
TIA / Stroke	Yes / No	Durn (Yrs)		On Meds	Never / Previous / Current
Other (specify)		Durn (Yrs)		On Meds	Never / Previous / Current
Section 3: Symptoms and Behavior					
Check all symptoms reported at baseline (regardless of intensity)					
☐ Headache ☐ Myalgia ☐ Lethargy ☐ Backache ☐ Shoulder pain ☐ Backache ☐ Chest pain	☐ Dyspepsia ☐ Heart burn ☐ Irritable bowel ☐ Constipation ☐ Abdominal pain ☐ Paresthesia ☐ Cold intolerance	☐ Sweating ☐ Hot flushes ☐ Edema ☐ Insomnia ☐ Palpitations ☐ Ghabrahat ☐ Breathlessness		☐ Cough ☐ Lack of energy ☐ Loss of libido ☐ Erectile dysfunction ☐ Premature ejaculation ☐ Any other (specify)	
Current Smoking	Yes / No	Durn (Yrs)		Frequency	Number per week
Tobacco to chew	Yes / No	Durn (Yrs)		Frequency	Grams per week
Alcohol	Yes / No	Durn (Yrs)		Frequency	Volume per week

Other addiction (specify)		Durn (Yrs)		Frequency		Volume per week	
Section 4: Anthropometry							
Pulse rate		Height (m)		Waist C		Neck C	
SBP		Weight (Kg)		Hip C		Calf C	
DBP		BMI		WHR		Thigh C	
MAP		BAI		WSR		Triceps	
Section 5: Body composition							
Body Fat %		TBW %		Bone mass			
Muscle mass		BMR		Visceral fat			
Section 6: Blood based test reports available at baseline							
FPG		Cholesterol		Hemoglobin		TSH	
PPG		Triglycerides		Urine microalbumin		FT4 / T4	
HbA1c		LDL		AST		T3	
Uric acid		HDL		ALT		TPO-Ab	
Section 7: Prescribed therapies							
Diet	Yes / No	If Yes, Details					
Physical activity	Yes / No	If Yes, Details					
Yoga	Yes / No	If Yes, Details					
Quit Tobacco	Yes / No	If Yes, Details					
Quit Alcohol	Yes / No	If Yes, Details					
Metformin	Yes / No	If Yes, Details					
Thyroxine	Yes / No	If Yes, Details					
Atorvastatin	Yes / No	If Yes, Details					

Vitamin D	Yes / No	If Yes, Details	
Vitamin B12	Yes / No	If Yes, Details	
Other (specify)		Details	
Section 8: Follow up advise			
Confirm willing of the person for follow up and provide date of follow up			
Signature (with date) of person filling up the form			

Annexure 2

PARTICIPANT INFORMATION SHEET (PIS)

1. STUDY TITLE: MAGNITUDE AND PREDICTORS OF SUBCLINICAL HYPOTHYROIDISM IN PATIENTS WITH IMPAIRED GLUCOSE TOLERANCE

2. STUDY INVESTIGATORS:

3. Student: Dr Tejaswita Chourey, General Medicine

4. Guide: Dr Rajnish Joshi, General Medicine

5. Co- Guide/s

Dr Abhishek Singhai, General Medicine

Dr Abhijit Pakhre, Department of Community and Family Medicine

Dr Rachna Parashar, Department of Physiology

6. Introduction: We are conducting a research study to determine magnitude and predictors of subclinical hypothyroidism in patients with impaired glucose tolerance in AIIMS Bhopal. We would like to appreciate your time and attention regarding the present study. We are inviting you to take part in this which is all about your participation. Your participation in the study is not compulsory. If you don't want to take part, you will kindly mention the reason of not taking part in this study as we want to know how easily population adapt this method and whether there are any factors affects the utility of the method, and it won't affect the work you do and you have to follow the advise of life style modification and periodic follow up for monitoring of your blood sugar status. If you do want to take part now, but change your mind later, you can pull out of the study at any time. Only if you agree to take part in this study, you will be asked to sign the Consent form.

7. Purpose of the study: The aim of our study is to determine predictors and magnitude of subclinical hypothyroidism in patients with impaired glucose tolerance.. This will

help us to find out the proportion of subclinical hypothyroidism in impaired glucose tolerance patient. what are the factors affecting IGT and SH including anthropometric risk factors (Body Mass Index, Waist Hip Ratio, Waist Circumference, BP, Body Composition analysis) and therapeutic effect in IGT and SH of the participants after three months of prescribed therapies by physician.

8. **Taking part – what it involves:** We expect you to provide complete details of the questions we provide to you. We would follow you up and will collect the relevant information and reports of investigations previously performed. We will also do perform a general examination and some body measurements. After getting these values we will assess response after therapy of 6 and 12 months, based on tests that your doctors would be suggesting as a routine for your care.

   i. **Do I have to take part?**

      Participation in this research is entirely voluntary. A decision to not take part, or to withdraw at any time, will not affect your rights or medical care in any way.

   ii. **What is expected of me if I take part?**

      We would follow you up and will collect the relevant information and reports of investigations previously performed. We will also do perform a general examination and some body measurements. After getting these values we will assess response after therapy of 12 months, based on tests that your doctors would be suggesting as a routine for your care.

   iii. **How long will my part in the study last?**

      Your participation in the study would last for 12 months.

iv. **Do I have to come for extra visits or undergo extra investigations for the study?**

You will need to perform no extra visits, beyond what is advised by your treating physicians.

v. **What are the possible benefits in taking part?**

Taking part will help gain knowledge about the proportion of subclinical hypothyroidism in impaired glucose tolerance patient, factors affecting IGT and SH including anthropometric risk factors and therapeutic effect in IGT and SH of the participants after three months of prescribed therapies by physician, which may result in improvement of management / outcomes for you / patients like yourself

vi. **What are the possible disadvantages and risks of taking part?**

There are no major foreseeable disadvantages or risks because of the study. There may be risk of loss of privacy and confidentiality of information collected even though all possible measures will be taken to ensure safe data storage and access.

vii. **What happens to the information collected from me?**

All information collected will be kept strictly confidential and not shared with anyone. Results from the study will be reported as group data and will not identify you in any way.

viii. **What if I change my mind regarding participation in the study?**
You are entitled to change your mind and withdraw at any time during the study without any disadvantage or penalty.

ix. **Whom do I contact for more information or if I have further questions or concerns?**

If you want any information or have questions or concerns, you can contact:

Dr. Tejaswita Chourey

Post graduate student,

Department of General Medicine

Mob: 7987245507

tejaswita.chourey@gmail.com

Dr. Shashank Purwar

Member Secretary,

Institute Ethics Committee – Student Research

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Annexure 3

प्रतिभागी सूचना पत्रक

1. अध्ययन का शीर्षक: बिगड़ा हुआ ग्लूकोज सहिष्णुता वाले रोगियों में उपनैदानिक हाइपोथायरायडिज्म का परिमाण और जोखिम कारक

2. अध्ययन अन्वेषक:

3. छात्र : डॉ. तेजस्विता चौरे, जनरल मेडिसिन

4. मार्गदर्शक: डॉ. रजनीश जोशी, जनरल मेडिसिन

5. सह- मार्गदर्शक:

डॉ अभिषेक सिंघई, जनरल मेडिसिन

डॉ अभिजीत पाखरे, सामुदायिक और परिवार चिकित्सा विभाग

डॉ रचना पराशर, शरीर विज्ञान विभाग

6. परिचयः हम एम्स भोपाल में बिगड़ा हुआ ग्लूकोज सहिष्णुता वाले रोगियों में उपनैदानिक हाइपोथायरायडिज्म के परिमाण और जोखिम कारक को निर्धारित करने के लिए एक शोध अध्ययन कर रहे हैं। हम वर्तमान अध्ययन के संबंध में आपके समय और ध्यान की सराहना करना चाहते हैं। हम आपको इसमें भाग लेने के लिए आमंत्रित कर रहे हैं जो आपकी भागीदारी के बारे में है। अध्ययन में आपकी भागीदारी अनिवार्य नहीं है। यदि आप भाग नहीं लेना चाहते हैं, तो कृपया इस अध्ययन में भाग न लेने के कारण का उल्लेख करें क्योंकि हम जानना चाहते हैं कि जनसंख्या कितनी आसानी से इस पद्धति को अपना लेती है और क्या कोई कारक हैं जो विधि की उपयोगिता को प्रभावित करते हैं, और यह आपके काम को प्रभावित नहीं करता है और आपको अपने रक्त शर्करा की स्थिति की निगरानी के लिए जीवन शैली में संशोधन की सलाह का पालन करना होगा। यदि आप अभी भाग लेना चाहते हैं, लेकिन बाद में अपना विचार बदलते हैं, तो आप किसी भी समय अध्ययन से बाहर हो सकते हैं। यदि आप इस अध्ययन में भाग लेने के लिए सहमत हैं, तो ही आपसे सहमति फॉर्म पर हस्ताक्षर करने के लिए कहा जाएगा।

7. अध्ययन का उद्देश्य: हमारे अध्ययन का उद्देश्य बिगड़ा हुआ ग्लूकोज सहिष्णुता वाले रोगियों में उपनैदानिक हाइपोथायरायडिज्म के भविष्यवाणियों और परिमाण का निर्धारण करना है। आईजीटी और एससीएच को प्रभावित करने वाले कारक कौन से हैं जिनमें एंथ्रोपोमेट्रिक जोखिम कारक (बॉडी मास इंडेक्स, कमर हिप अनुपात, कमर परिधि, बीपी, शारीरिक संरचना विश्लेषण) और आईजीटी और एससीएच में चिकित्सीय प्रभाव शामिल हैं, चिकित्सक द्वारा निर्धारित उपचारों के 12 महीने बाद ।

8. भाग लेना - इसमें क्या शामिल है: हम आपसे उन प्रश्नों का पूरा विवरण प्रदान करने की अपेक्षा करते हैं जो हम आपको प्रदान करते हैं। हम आपका अनुसरण करेंगे और प्रासंगिक जानकारी और पूर्व में की गई जांच की रिपोर्ट एकत्र करेंगे। हम एक सामान्य परीक्षा और शरीर के कुछ माप भी करेंगे। इन मूल्यों को प्राप्त करने के बाद हम 12 महीने की चिकित्सा के बाद प्रतिक्रिया का आकलन करेंगे, उन परीक्षणों के आधार पर जो आपके डॉक्टर आपकी देखभाल के लिए नियमित रूप से सुझाएंगे।

a) क्या मुझे भाग लेना है?

इस शोध में भागीदारी पूरी तरह से स्वैच्छिक है। भाग न लेने या किसी भी समय शोध से हटने का निर्णय किसी भी तरह से आपके अधिकारों या चिकित्सा देखभाल को प्रभावित नहीं करेगा।

b) यदि मैं भाग लेता हूँ तो मुझसे क्या अपेक्षा की जाती है?

हम आपका अनुसरण करेंगे और प्रासंगिक जानकारी और पूर्व में की गई जांच की रिपोर्ट एकत्र करेंगे। हम एक सामान्य परीक्षा और शरीर के कुछ माप भी करेंगे। इन मूल्यों को प्राप्त करने के बाद हम 6 महीने और 12 महीने की चिकित्सा के बाद प्रतिक्रिया का आकलन करेंगे, उन परीक्षणों के आधार पर जो आपके डॉक्टर आपकी देखभाल के लिए नियमित रूप से सुझाएंगे।

c) अध्ययन में मेरा हिस्सा कितने समय तक चलेगा?

अध्ययन में आपकी भागीदारी 12 महीने तक चलेगी।

d) क्या मुझे अध्ययन के लिए अतिरिक्त मुलाकातों या अतिरिक्त जांचों के लिए आना होगा?

आपके इलाज करने वाले चिकित्सकों द्वारा दी गई सलाह के अलावा आपको कोई अतिरिक्त दौरा करने की आवश्यकता नहीं होगी।

e) भाग लेने के संभावित लाभ क्या हैं? भाग लेने से बिगड़ा हुआ ग्लूकोज

सहिष्णुता रोगी में उपनैदानिक हाइपोथायरायडिज्म के अनुपात के बारे में ज्ञान प्राप्त करने में मदद मिलेगी, आईजीटी और एससीएच को प्रभावित करने वाले कारकों में एंथ्रोपोमेट्रिक जोखिम कारक और आईजीटी और एससीएच में उपचारात्मक प्रभाव चिकित्सक द्वारा निर्धारित उपचारों के तीन महीने बाद हो सकता है, जिसके परिणामस्वरूप,प्रबंधन में सुधार आप जैसे रोगी के लिए हो सकता है ।

f) भाग लेने के संभावित नुकसान और जोखिम क्या हैं?

अध्ययन की वजह से कोई बड़ा अनुमानित नुकसान या जोखिम नहीं हैं। एकत्र की गई जानकारी की गोपनीयता और गोपनीयता की हानि का जोखिम हो सकता है, भले ही सुरक्षित डेटा भंडारण सुनिश्चित करने के लिए सभी संभव उपाय किए जाएंगे।

g) मुझसे एकत्र की गई जानकारी का क्या होता है?

एकत्र की गई सभी सूचनाओं को गोपनीय रखा जाएगा और किसी के साथ साझा नहीं किया जाएगा। अध्ययन के परिणाम, डेटा के रूप में रिपोर्ट किए जाएंगे और किसी भी तरह से आपकी पहचान नहीं करेंगे।

h) क्या होगा अगर मैं अध्ययन में भाग लेने के बारे में अपना विचार बदल दूं?

आप अपना विचार बदलने और अध्ययन के दौरान किसी भी समय बिना किसी नुकसान या दंड के आप किसी भी समय अध्ययन से बाहर हो सकते हैं।

i) अधिक जानकारी के लिए या मेरे और प्रश्न या चिंताएँ होने पर मैं किससे संपर्क करूँ?

यदि आप कोई जानकारी चाहते हैं या आपके कोई प्रश्न या चिंताएँ हैं, तो आप संपर्क कर सकते हैं:

डॉ. तेजस्विता चौरे

स्नातकोत्तर छात्र

सामान्य चिकित्सा

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डॉ. शशांक पुरवार

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Annexure 4

प्रतिभागी सूचना सहमति प्रपत्र

[PARTICIPANT INFORMED CONSENT FORM (PICF)]

इस अध्ययन के लिए प्रतिभागी का पहचान
नंबरः…….

Participant Identification Number for this
Study:.....

अनुसंधान का शीर्षकः क्षीण ग्लूकोज सहनशीलता वाले रोगियों में उपनैदानिक हाइपोथायरायडिज्म का परिमाण और जोखिम कारक

Title of Project: MAGNITUDE AND PREDICTORS OF SUBCLINICAL HYPOTHYROIDISM IN PATIENTS WITH IMPAIRED GLUCOSE TOLERANCE

शोधकर्ता छात्र का नाम: डॉ. तेजस्विता चौरे फोन नं: 7987245507

Name of Student Investigator: DR. TEJASWITA CHOUREY Tel No.(s): 7987245507

शोध मार्गदर्शक का नाम : डॉ. रजनीश जोशी

Name of Thesis Guide: DR. RAJNISH JOSHI

मैंने दिनांक 14.01.2023 के सूचना पत्रक संस्करण II में दिए गए सभी तथ्यों को सावधानीपूर्वक पढ़ लिया है। मुझे अपनी भाषा में स्पष्ट रूप से विस्तारपूर्वक समझा दिया गया है, और मैंने तथ्यों को पूर्णतः समझ लिया है। मैं पुष्टि करता/करती हूँ, कि मुझे सवाल पूछने के अवसर प्रदान किए गए।

The contents of the information sheet version II dated 14 JANUARY 2023 that was provided have been read carefully by me / explained in detail to me, in a language that I comprehend, and I have fully understood the contents. I confirm that I have had the opportunity to ask questions.

मुझे इस अध्ययन की प्रकृति एवं उद्देश्य और इसके संभावित जोखिमों / लाभों तथा अध्ययन की अनुमानित अवधि एवं अन्य प्रासंगिक जानकारी के बारे में विस्तारपूर्वक समझा दिया गया है। मुझे पता है कि इस अध्ययन में मेरी भागीदारी स्वैच्छिक है तथा मैं इस अध्ययन से किसी भी समय बिना कोई कारण बताए, अपना नाम वापस लेने के लिए स्वतंत्र हूं और नाम वापस लेने पर मेरी चिकित्सा देखभाल या कानूनी अधिकारों पर कोई प्रभाव नहीं पड़ेगा |

The nature and purpose of the study and its potential risks/benefits and expected duration of the study, and other relevant details of the study have been explained to me in detail. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal right being affected.

मैं समझता/समझती हूं कि इस अनुसंधान में मेरी भागीदारी से मेरे बारे में एकत्र की गई जानकारी और मेरे चिकित्सीय दस्तावेजों के किसी भी भाग को एम्स के जिम्मेदार व्यक्तियों द्वारा ही देखा जाएगा। मैं इन व्यक्तियों को मेरे रिकॉर्ड प्राप्त करने की अनुमति प्रदान करता / करती हूँ।

I understand that the information collected about me from my participation in this research and sections of any of my medical notes may be looked at by responsible individuals from AIIMS. I give permission for this individuals to have access to my records.

मैं उक्त अध्ययन में भाग लेने के लिए सहमत हूं / I agree to take part in the above study.

प्रतिभागी के हस्ताक्षर / बांए अंगूठे का निशान (Signature / Left Thumb Impression)

दिनांक/Date…….स्थान / Place…….

प्रतिभागी का नाम/ Name of the participant.....

पिता/पति/पत्नी का नाम /Son / Daughter / Spouse of ……..

डाक का पूरा पता / Complete Postal Address……

अगर अशिक्षित हों / If illiterate

सूचना पत्र को प्रतिभागी को पढ़ा और समझाया गया है और प्रश्न पूछने का अवसर दिया गया है। मैं पुष्टि करता हूं कि व्यक्ति ने स्वतंत्र रूप से अपनी सहमति दी है ।

The information sheet has been read and explained to the participant and given the opportunity to ask questions. I confirm that the individual has given consent freely.

कानूनी रूप से स्वीकार्य प्रतिनिधि या निष्पक्ष गवाह के हस्ताक्षर

Signature of Legally acceptable representative or impartial witness.

दिनांक / Date……..

एलएआर या निष्पक्ष गवाह का नाम / Name of LAR or impartial witness

पता / Address…….....

प्रमाणित किया जाता है कि उक्त सहमति मेरी उपस्थिति में प्राप्त की गई ।

This is to certify that the above consent has been obtained in my presence.

छात्र शोधकर्ता के हस्ताक्षर

Signature of the student Investigator

दिनांक/Date…….. स्थान/Place……..

Master sheet

Master sheet

	NAME	AGE	SEX	UHID	FBS	CAMP SUGAR	HBA1c	TSH	ADDICTION	TOBACCO USE	TOBACCO YEAR	CURRENT USE	ALCOHOL USE	ALCOHOL YEAR	CURRENT USE	comorbidities
1	Sb	65	F	2308601	113	112	5.9	2.11	0	0	0	0	0	0	0	1
2	Va	32	M	1901503	103	142	5.8	2.2	0	0	0	0	0	0	0	0
3	Ge	45	F	2000202	104	130	6.1	2.13	0	0	0	0	0	0	0	0
4	Na	46	M	2703602	109	127	6.1	5.09	1	1	5	1	0	0	0	1
5	Ra	80	F	2718503	123	112	6.1	2.12	0	0	0	0	0	0	0	0
6	Rp	45	M	2003701	129	123	5.9	3.89	1	1	11	1	0	0	0	0
7	Di	46	M	2008001	101	101	5.8	3.23	1	1	10	1	0	0	1	0
8	Ka	48	M	2116001	111	113	6.34	1.82	0	0	0	0	0	0	0	0
9	Ma	55	F	2316501	103	149	6.3	4.35	0	0	0	0	0	0	0	0
10	Ga	43	F	2019502	116	109	5.7	3.6	0	0	0	0	0	0	0	0
11	An	42	M	2020001	115	159	6.2	4.29	0	0	0	0	0	0	0	0
12	Mo	56	M	2600802	107	119	5.8	2.01	0	0	0	0	0	0	0	0
13	Su	70	F	2619001	104	165	6.2	6.1	0	0	0	0	0	0	0	0
14	Ni	50	M	2006601	135	114	5.7	9.23	0	0	0	0	0	0	0	1
15	Sa	35	F	2006502	131	130	6.4	5	1	1	5	1	0	0	0	0
16	Hi	62	M	2114301	100	254	5.8	2.22	0	0	0	0	0	0	0	1
17	Go	30	F	1910802	112	140	6.3	1.91	0	0	0	0	0	0	0	0
18	Sn	30	F	2614402	132	150	6.2	3.47	0	0	0	0	0	0	0	0
19	Kk	63	M	2113601	113	134	6.4	3.7	0	0	0	0	0	0	0	0
20	Ck	55	F	2015302	112	125	5.8	3.6	0	0	0	0	0	0	0	0
21	Hb	60	F	1904906	108	136	5.8	2.03	0	0	0	0	0	0	0	1
22	Sr	60	M	2114101	118	123	5.8	1.01	0	0	0	0	0	0	0	0
23	An	41	F	2013802	111	164	6	3.27	0	0	0	0	0	0	0	0
24	Ra	50	M	2011401	111	117	5.8	1.96	0	0	0	0	0	0	0	0
25	Hl	70	M	2015705	115	154	5.8	2.22	1	1	13	1	1	4	0	0
26	Dl	51	M	2509901	108	106	5.8	12.5	0	0	0	0	0	0	0	1
27	Kb	50	F	2110301	111	125	6.2	2.71	0	0	0	0	0	0	0	1
28	Ms	41	F	2017202	106	111	5.8	3.12	0	0	0	0	0	0	0	0
29	Hs	43	M	2011901	102	108	5.7	1.72	0	0	0	0	0	0	0	0
30	Ab	45	M	2507101	117	123	5.8	5.86	0	0	0	0	0	0	0	0
31	Ko	54	M	1917501	106	105	5.8	4.18	1	1	10	1	0	0	0	0
32	Ke	51	M	2003901	116	121	6.3	2.99	1	1	5	1	0	0	0	0
33	Mb	32	F	2316102	116	128	6.3	2.55	0	0	0	0	0	0	0	0
34	Vi	40	F	1909209	125	140	5.9	3.96	0	0	0	0	0	0	0	0
35	Dc	64	M	2119201	121	136	6.3	3.19	1	1	30	1	0	0	0	0
36	Sb	31	F	2602602	112	112	5.8	2.79	0	0	0	0	0	0	0	0
37	Sh	42	F	2021006	105	101	5.7	5.43	0	0	0	0	0	0	0	0
38	Bh	35	F	2314002	107	117	6.3	2.48	0	0	0	0	0	0	0	0
39	Dp	30	F	2305302	109	155	6.4	3.23	0	0	0	0	0	0	0	0
40	Rk	55	M	2002503	106	103	6.2	2.12	1	0	0	0	1	10	1	0
41	Ru	35	F	2021010	117	127	6	0.61	0	0	0	0	0	0	0	0
42	Sm	40	F	1905602	125	130	6.3	1.24	0	0	0	0	0	0	0	0
43	Sd	37	F	2320402	103	144	6.3	1.55	0	0	0	0	0	0	0	0
44	Mu	50	M	2611601	112	123	5.7	1.44	0	0	0	0	0	0	0	0
45	Kl	37	M	2711602	113	126	5.9	3.7	0	0	0	0	0	0	0	0
46	Kg	70	F	2008201	100	186	6.3	1.78	0	0	0	0	0	0	0	0
47	Ds	70	F	2301802	104	124	5.9	14.04	0	0	0	0	0	0	0	1
48	Bj	40	M	2013401	107	117	6.3	0.39	0	0	0	0	0	0	0	0
49	Rb	60	F	2320001	103	137	6.3	1.9	0	0	0	0	0	0	0	0
50	Sd	53	M	2024301	111	129	5.9	3.37	1	1	7	1	0	0	0	0

	NAME	AGE	SEX	UHID	HTN	DURATION YE	IHD	STROKE	complaints	WEIGHT	HEIGHT	NC	WC	HC	TC	CC	
1	Sb	65	F	2308601	1	7	0	0	0	52	165	34	79	84	42	33	
2	Va	32	M	1901503	0	0	0	0	0	68	151	32	105	91	48	36	
3	Ge	45	F	2000202	0	0	0	0	0	57	150	30	90	98	42	34	
4	Na	46	M	2703602	1	1	0	0	0	52	154	34	81	82	39	31	
5	Ra	80	F	2718503	0	0	0	0	0	44	148	34	74	89	35	34	
6	Rp	45	M	2003701	0	0	0	0	0	57	155	34	97	86	41	35	
7	Dl	46	M	2008001	0	8	0	0	0	55	160	34	88	85	37	29	
8	Ka	48	M	2116001	0	0	0	0	0	52	163	34	73	81	40	32	
9	Ma	55	F	2316501	0	0	0	0	0	57.5	154	33	96	90	40	31	
10	Ga	43	F	2019502	0	0	0	0	0	85	169	30	102	94	47	42	
11	An	42	M	2020001	0	0	0	0	0	51	160	33	75	84	40	33	
12	Mo	56	M	2600802	0	0	0	0	0	80	152	34	117	100	42	34	
13	Su	70	F	2619001	0	0	0	0	1	61	153	32	100	86	36	31	
14	Ni	50	M	2006601	1	4	0	0	1	67	163	32	99	93	42	32	
15	Sa	35	F	2006502	0	0	0	0	0	43	147	33	85	77	42	29	
16	Hi	62	M	2114301	1	8	0	0	0	46	158	31	73	81	38	29	
17	Go	30	F	1910802	0	0	0	0	0	48	158	31	86	92	42	30	
18	Sh	30	F	2614402	0	0	0	0	0	46	150	33	97	90	52	33	
19	Kk	63	M	2113601	0	0	0	0	0	47	160	33	72	82	40	30	
20	Ck	55	F	2015302	0	0	0	0	0	52	144	35	90	92	42	35	
21	Hb	60	F	1904906	1	4	0	0	0	72	150	36	107	96	45	30	
22	Sr	60	M	2114101	0	0	0	0	0	47	166	32	72	70	40	32	
23	An	41	F	2013802	0	0	0	0	0	60	156	33	88	93	43	32	
24	Ra	60	M	2011401	0	0	0	0	0	71	158	34	103	90	47	37	
25	Hl	70	M	2015705	0	0	0	0	0	73	159	30	98	94	46	38	
26	Dl	51	M	2508901	1	3	0	0	0	65	160	31	106	90	49	39	
27	Kb	50	F	2110301	1	4	0	0	0	67	157	35	100	90	44	34	
28	Ms	41	F	2017202	0	0	0	0	0	61	162	31	96	89	42	33	
29	Hs	43	M	2011901	0	0	0	0	0	78	162	34	121	96	40	40	
30	Ab	45	M	2507101	0	0	0	0	1	76	163	33	120	95	43	41	
31	Ko	64	M	1917501	0	0	0	0	0	62	160	35	90	94	35	33	
32	Ke	51	M	2003901	0	0	0	0	0	58	164	35	88	91	39	30	
33	Mb	32	F	2316102	0	0	0	0	0	55	147	33	104	95	44	35	
34	Vi	40	F	1908209	0	0	0	0	0	63	159	34	102	97	44	33	
35	Dc	64	M	2119201	0	0	0	0	0	60	168	35	98	89	40	32	
36	Sb	31	F	2602602	0	0	0	0	0	69	150	36	108	96	42	36	
37	Sh	42	F	2021006	0	0	0	0	0	60	152	31	100	90	40	33	
38	Bh	35	F	2314002	0	0	0	0	1	55	152	32	98	87	43	33	
39	Dp	30	F	2306302	0	0	0	0	0	115	160	43	128	139	56	44	
40	Rk	55	M	2002503	0	0	0	0	0	55	148	35	96	92	54	35	
41	Ru	35	F	2021010	0	0	0	0	0	94	168	36	119	120	46	38	
42	Sm	40	F	1905602	0	0	0	0	0	46	155	32	89	82	36	34	
43	Sd	37	F	2320402	0	0	0	0	0	63	158	33	97	97	46	38	
44	Mu	50	M	2611601	0	0	0	0	0	112	154	36	117	138	50	40	
45	Ki	37	M	2711602	0	0	0	0	0	65	158	33	99	90	44	34	
46	Kg	70	F	2008201	0	0	0	0	0	56	148	34	96	94	42	35	
47	Ds	70	F	2301802	1	5	0	0	0	57	147	32	98	114	42	35	
48	Bj	40	M	2013401	0	0	0	0	0	66	168	35	104	94	51	42	
49	Rb	60	F	2320001	0	0	0	0	0	54	146	34	89	95	42	34	
50	Sd	53	M	2024301	0	0	0	0	0	71	164	33	100	94	38	33	

	NAME	AGE	SEX	UHID	WHR	WSR	BMI	TBW	FAT	LBM/BAI	SBP	DBP	PR	MAP	PRESCRIPTION	Life style measi
1	Sb	65	F	2308601	0.940476190	0.478787878	19.10009183	31.2	49.474962		126	74	69	91.33333333	1	1
2	Va	32	M	1901503	1.153846154	0.695364238	29.82325337	40.8	44.34805381		114	72	64	86	1	1
3	Ge	45	F	2000202	0.918367347	0.6	25.33333333	34.2	67.89123569		111	74	82	86.33333333	1	1
4	Na	46	M	2703602	0.987804878	0.525974026	21.92612582	31.2	27.30318547		155	87	106	109.6666667	1	1
5	Ra	80	F	2718503	0.831460674	0.5	20.08765522	28.4	54.08762931		118	73	78	88	1	1
6	Rp	45	M	2003701	1.127906977	0.625806451	23.72528616	34.2	38.0504852		132	80	81	97.33333333	1	1
7	Di	46	M	2008001	1.005294118	0.55	21.484375	33	31.3266237		118	88	87	98	1	1
8	Ka	48	M	2116001	0.901234568	0.447852761	19.57166128	31.2	18.6058704		116	81	97	92.66666667	1	1
9	Ma	55	F	2316501	1.066666667	0.623376623	24.24523528	34.5	64.49554096		139	79	91	99	1	1
10	Ga	43	F	2019502	1.085106383	0.603550296	29.76086271	51	66.3327672		112	74	82	86.66666667	1	1
11	An	42	M	2020001	0.892857143	0.46875	19.921875	30.6	21.93910788		124	78	89	93.33333333	1	1
12	Mo	56	M	2800802	1.17	0.769736842	34.62603878	48	48.94358183		132	86	88	101.3333333	1	1
13	Su	70	F	2619001	1.052631579	0.653594771	26.05835362	36.6	69.2694901		161	59	82	93	1	1
14	Ni	50	M	2008601	1.064516129	0.607361963	25.21735858	40.2	38.81907297		124	82	88	96	1	1
15	Sa	35	F	2006502	1.103896104	0.578231293	19.89911611	25.8	54.37523641		122	88	76	99.33333333	1	1
16	Hi	62	M	2114301	0.901234568	0.462025316	18.42653421	27.6	22.3217291		173	96	62	121.6666667	1	1
17	Go	30	F	1910602	0.934782609	0.544303797	19.22766787	28.8	60.57220136		115	68	70	83.66666667	1	1
18	Sn	30	F	2614402	1.077777778	0.646666667	20.44444444	27.6	66.07372506		126	80	84	95.33333333	1	1
19	Kk	63	M	2113601	0.878048780	0.45	18.359375	28.2	19.17090327		142	66	73	91.33333333	1	1
20	Ck	55	F	2015302	0.978260870	0.625	25.07716049	31.2	64.50817739		143	85	82	104.3333333	1	1
21	Hb	60	F	1904906	1.114583333	0.713333333	32	43.2	71.81784749		124	86	79	98.66666667	1	1
22	Sr	60	M	2114101	1.028571429	0.433734940	17.05617651	28.2	18.99680937		128	90	84	102.6666667	1	1
23	An	41	F	2013802	0.946236559	0.564102564	24.65483235	36	61.59315249		108	63	78	78	1	1
24	Ra	50	M	2011401	1.144444444	0.651898734	28.44095498	42.6	40.86546792		130	74	100	92.66666667	1	1
25	Hi	70	M	2015705	1.042553191	0.616352201	28.87544005	43.8	40.12823699		126	75	89	92	1	1
26	Di	51	M	2509901	1.177777778	0.6625	25.390625	39	43.59745568		150	95	84	113.3333333	1	1
27	Kb	50	F	2110301	1.111111111	0.636942675	27.18163009	40.2	64.5876675		179	108	89	131.6666667	1	1
28	Ms	41	F	2017202	1.078651685	0.592592593	23.24340802	36.6	62.80889262		111	66	76	81	1	1
29	Hs	43	M	2011901	1.260416667	0.746913580	29.7210791	46.8	48.7636193		132	87	88	102	1	1
30	Ab	45	M	2507101	1.263157895	0.736196319	28.60476495	45.6	48.57643111		166	97	82	120	1	1
31	Ko	54	M	1917501	0.957446808	0.5625	24.21875	37.2	32.01203134		133	89	87	103.6666667	1	1
32	Ke	51	M	2003901	0.967032967	0.536585366	21.56454491	34.8	29.87730443		128	79	79	95.33333333	1	1
33	Mb	32	F	2316102	1.094736842	0.707482993	25.45235781	33	72.2491833		121	76	84	91	1	1
34	Vi	40	F	1909209	1.051546392	0.641509434	24.91990032	37.8	68.49199601		108	97	93	100	1	1
35	Dc	64	M	2119201	1.101123596	0.583333333	21.2585034	36	35.6006857		111	65	66	80.33333333	1	1
36	Sb	31	F	2602602	1.125	0.72	30.66666667	41.4	72.2410074		127	79	79	95	1	1
37	Sh	42	F	2021006	1.111111111	0.657894737	25.96952909	36	67.776536		136	86	100	102.6666667	1	1
38	Bh	35	F	2314002	1.126436782	0.644736842	23.80540166	33	65.0500833		158	89	100	112	1	1
39	Dp	30	F	2305302	0.920863309	0.8	44.921875	69	89.89378793		133	79	78	97	1	1
40	Rk	55	M	2002503	1.043478261	0.648648649	25.10956903	33	38.25108856		112	70	79	84	1	1
41	Ru	35	F	2021010	0.991666667	0.708333333	33.30498886	56.4	80.84688023		120	82	83	94.66666667	1	1
42	Sm	40	F	1906602	1.085365854	0.574193548	19.14672216	27.6	57.4191302		132	86	82	101.3333333	1	1
43	Sd	37	F	2320402	1	0.613924050	25.23634033	37.8	67.02019284		107	70	80	82.33333333	1	1
44	Mu	50	M	2611601	0.847826087	0.759740260	47.22550177	67.2	47.63484519		147	66	84	93	1	1
45	Kl	37	M	2711602	1.1	0.626582278	26.03748399	38	39.20503153		152	93	67	112.6666667	1	1
46	Kg	70	F	2008201	1.021276596	0.648648649	25.56610655	33.6	67.55773571		116	86	83	96	1	1
47	Ds	70	F	2301602	0.859649123	0.666666667	26.3778981	34.2	77.96819194		131	83	70	99	1	1
48	Bj	40	M	2013401	1.106382979	0.619047619	23.38435374	39.6	38.9987482		136	87	86	103.3333333	1	1
49	Rb	60	F	2320001	0.936842105	0.660568904	25.33308313	32.4	65.35498698		124	86	84	98.66666667	1	1
50	Sd	53	M	2024301	1.063829787	0.609756098	26.39797739	42.6	38.63303066		130	89	88	102.6666667	1	1

	NAME	AGE	SEX	UHID	Metformin	OTHER	Thyroxine		FU_BS	FU_HbA1c	FU_TSH	FU_WEIGHT	FU_HEIGHT	FU_NC	FU_WC	FU_HC
1	Sb	65	F	2308601	0	0	0									
2	Va	32	M	1901503	0	0	0									
3	Ge	45	F	2003202	0	0	0									
4	Na	46	M	2703602	0	1	0									
5	Ra	80	F	2718503	0	0	0		108	5.4	1.72	42	148	34	73	87
6	Rp	45	M	2003701	0	0	0									
7	Di	46	M	2008001	0	0	0									
8	Ka	48	M	2116001	0	0	0									
9	Ma	55	F	2316501	0	1	0									
10	Ga	43	F	2019502	0	0	0									
11	An	42	M	2020001	0	0	0									
12	Mo	56	M	2603802	0	0	0									
13	Su	70	F	2619001	0	1	0		135	5.59	1.85	83	152	35	118	99
14	Ni	50	M	2006601	0	1	0		122	7.2	4.12	64	153	34	102	96
15	Sa	35	F	2006502	0	0	0									
16	Hi	62	M	2114301	0	1	0									
17	Go	30	F	1910802	0	0	0									
18	Sn	30	F	2614402	0	0	0		91	4.7	3.89	43.5	150	33	73	80
19	Kk	63	M	2113601	0	0	0									
20	Ck	55	F	2015302	0	0	0									
21	Hb	60	F	1904906	0	0	0									
22	Sr	60	M	2114101	0	0	0		144	4.8	1.28	45	166	32	72	70
23	An	41	F	2013802	0	0	0									
24	Ra	50	M	2011401	0	0	0									
25	Hi	70	M	2015705	0	0	0									
26	Di	51	M	2509901	0	1	0									
27	Kb	50	F	2110301	0	1	0									
28	Ms	41	F	2017202	0	0	0									
29	Hs	43	M	2011901	0	0	0									
30	Ab	45	M	2507101	0	1	0									
31	Ko	54	M	1917501	0	0	0									
32	Ke	51	M	2003901	0	0	0									
33	Mb	32	F	2316102	0	0	0									
34	Vi	40	F	1909209	0	0	0									
35	Dc	64	M	2119201	0	0	0									
36	Sb	31	F	2602602	0	0	0									
37	Sh	42	F	2021006	0	0	1									
38	Bh	35	F	2314002	0	1	0		110	5.3	1.4	55	152	32	97	88
39	Dp	30	F	2305302	1	0	0									
40	Rk	55	M	2002503	0	0	0									
41	Ru	35	F	2021010	0	0	0									
42	Sm	40	F	1905602	0	0	0									
43	Sd	37	F	2320402	0	0	0									
44	Mu	50	M	2611601	0	0	0									
45	Kl	37	M	2711602	0	0	0									
46	Kg	70	F	2008201	0	0	0									
47	Ds	70	F	2301802	0	0	1									
48	Bj	40	M	2013401	0	0	0									
49	Rb	60	F	2320001	0	0	0									
50	Sd	53	M	2024301	0	0	0									

	NAME	AGE	SEX	UHID	FU_TC	FU_CC	FU_BMI	FU_SBP	FU_DBP	FU_PR	FU MAP		2FUP RBS	2FUP HBA1C	2FUP TSH	SBP
1	Sb	65	F	2308601									157	5.6	2.9	117
2	Va	32	M	1901503									107	4.9	3.3	124
3	Ge	45	F	2000202									115	5.2	5.18	136
4	Na	48	M	2703602									101	4.6	2.78	135
5	Ra	60	F	2708503	35	33	19.1745799	123	92	86	95.6666667					
6	Rp	45	M	2003701									108	5.2	1.5	133
7	Dl	46	M	2008001												
8	Ka	48	M	2116001												
9	Ma	55	F	2316501									167	5.3	0.5	129
10	Ga	43	F	2019502									85	4.8	2.93	109
11	An	42	M	2020001									105	4.9	0.15	134
12	Mo	58	M	2600802	42	35	35.92451524	132	84	88	100		121	5.2	1.52	122
13	Su	70	F	2619001	36	32	27.338912	119	83	87	95		210	12	1.76	112
14	Ni	50	M	2006601												
15	Sa	35	F	2006502									88	5.2	6.7	136
16	Hi	62	M	2114301									99	5.4	13.19	156
17	Go	30	F	1910802												
18	Sn	30	F	2614402	35	28	19.33333333	130	81	89	97.33333333		95	4.8	8.76	128
19	Kk	63	M	2113601									130	5.6	1.29	128
20	Ck	55	F	2015302									90	5	7.28	165
21	Hb	60	F	1904906									130	5.7	2.08	112
22	Sr	60	M	2114101	38	31	16.33038177	128	79	76	95.33333333		113	5	0.26	123
23	An	41	F	2013802									105	5	8.02	131
24	Ra	50	M	2011401									106	5.1	0.75	127
25	Hl	70	M	2015705									119	5.7	2.27	139
26	Dl	51	M	2509901									150	5.4	1.14	150
27	Kb	50	F	2110301									115	5.5	2.42	160
28	Ms	41	F	2017202									120	5.6	3.82	120
29	Hs	43	M	2011901												
30	Ab	45	M	2507101									126	5.2	3.05	134
31	Ko	54	M	1917501									116	5.2	1.69	126
32	Ke	51	M	2003901									112	6.8	1.38	129
33	Mb	32	F	2316102									125	5.2	1.59	119
34	Vi	40	F	1909209									130	7.1	1.99	136
35	Dc	64	M	2119201									88	5.2	6.7	117
36	Sb	31	F	2602602									114	5.8	1.74	124
37	Sh	42	F	2021006									132	5.5	4.26	121
38	Bh	35	F	2314002	40	33	23.80540166	131	82	79	98.33333333		112	5.7	1.04	126
39	Dp	30	F	2305302									109	5.6	4.66	134
40	Rk	55	M	2002503												
41	Ru	35	F	2021010									103	4.9	3.18	111
42	Sm	40	F	1905602												
43	Sd	37	F	2320402									73	5.6	0.29	130
44	Mu	60	M	2611601									99	5.8	0.1	132
45	Kl	37	M	2711602									121	3.9	4	124
46	Kg	70	F	2008201												
47	Ds	70	F	2301802												
48	Bj	40	M	2013401									123	5.3	2.67	126
49	Rb	60	F	2320001									120	4.9	2.73	122
50	Sd	63	M	2024301												

	NAME	AGE	SEX	UHID	DBP	PR	2-MAP	WT	HT	NC	WC	HC	TC	CC	2-FU BMI
1	Sb	65	F	2308601	86	73	96.3333333	50	165	34	77	82	40	30	18.36547291
2	Va	32	M	1901503	80	69	94.6666667	66.5	151	32	102	92	47	35	29.16538748
3	Ge	45	F	2002202	89	72	104.666667	58	150	31	92	100	42	36	25.77777778
4	Na	46	M	2703602	85	84	101.666667	53	154	34	84	83	40	35	22.34778209
5	Ra	80	F	2718503											
6	Rp	45	M	2003701	77	83	95.6666667	55	155	33.5	95	84	39	34	22.89281998
7	Di	46	M	2008001											
8	Ka	48	M	2116001											
9	Ma	56	F	2316501	64	82	85.6666667	55	154	33	94.5	89	36	29	23.19109462
10	Ga	43	F	2019502	80	80	89.6666667	85	169	31	102	95	46	41	29.76086271
11	An	42	M	2020001	85	86	101.333333	48	160	32	74	82	38	31	18.75
12	Mo	56	M	2600802	84	86	96.6666667	82	152	35	118	99	42	35	35.49168975
13	Su	70	F	2619001	82	84	105.333333	67	153	35	104	100	38	34	28.62147037
14	Ni	50	M	2006601											
15	Sa	35	F	2006502	90	74	105.333333	44.5	147	33	86.5	80	42	33	20.59327132
16	Hi	62	M	2114301	92	86	113.333333	49	158	32	76	84	43	32	19.6282647
17	Go	30	F	1910802											
18	Sn	30	F	2614402	90	84	102.666667	45	150	33	74	84	35	30	20
19	Kk	63	M	2113601	84	93	98.6666667	48	160	33	74	84	42.5	33	18.75
20	Ck	55	F	2015302	90	67	115	54.5	144	35	93	94	43	36	26.28279321
21	Hb	60	F	1904906	82	70	92	72	150	36	109	98	45	32	32
22	Sr	60	M	2114101	89	75	100.333333	44	166	33	73	70	37	30	15.9674844
23	An	41	F	2013802	83	79	99	63	156	33	91	94.5	42.5	35	25.88757396
24	Ra	50	M	2011401	78	86	94.3333333	69.5	158	34	101	89	45	35	27.84000973
25	Hl	70	M	2015705	83	79	101.666667	72	159	31	96.5	93	44	36.5	28.47988608
26	Dl	51	M	2509901	88	80	108.666667	62.5	160	31	103.5	91	45	34	24.4140625
27	Kb	50	F	2110301	100	84	120	66.5	157	34	99	89	44	35	26.9787821
28	Ms	41	F	2017202	80	71	93.3333333	61	162	32	97	88.5	42	34	23.24340802
29	Hs	43	M	2011901											
30	Ab	45	M	2507101	83	83	100	75.5	163	33	119	95	42.5	39	28.41657571
31	Ko	54	M	1917501	86	81	99.3333333	61	160	35	87	90	36	32	23.828125
32	Ke	51	M	2003901	92	82	104.333333	58	164	35	89	90	38	30	21.56454491
33	Mb	32	F	2316102	68	86	85	54	147	33	104	95	44	35	24.98958767
34	Vi	40	F	1909209	85	77	102	65	159	34	105	97	45	34	25.71108827
35	Dc	64	M	2119201	70	89	85.6666667	61.5	168	35.5	100	90	40.5	34	21.78996599
36	Sb	31	F	2602602	73	80	90	68	150	36	106.5	95	41	35	30.22222222
37	Sh	42	F	2021006	82	83	95	62	152	32	102	92	42	34	26.8351806
38	Bh	35	F	2314002	84	86	98	54	152	32	96	89	40	32	23.37256718
39	Dp	30	F	2305302	85	90	101.333333	113	160	42	127	136	53	43	44.140625
40	Rk	56	M	2002503											
41	Ru	35	F	2021010	72	77	85	91	168	35	115	117	44	35	32.24206349
42	Sm	40	F	1905802											
43	Sd	37	F	2320402	80	82	96.6666667	62	158	33	95	96	44	36	24.8357635
44	Mu	50	M	2611601	86	88	101.333333	110	154	36	114	135	48	40	46.38218924
45	Kl	37	M	2711602	84	90	97.3333333	65	158	33	100	91	43	34	26.03749399
46	Kg	70	F	2008201											
47	Ds	70	F	2301802											
48	Bj	40	M	2013401	78	83	94	65	168	35	102	93	50	42	23.03004535
49	Rb	60	F	2320001	83	79	96	52.5	146	34	87	94	41	34	24.62938638
50	Sd	53	M	2024301											

	NAME	AGE	SEX	UHID	FBS	CAMP SUGAR	HBA1c	TSH	ADDICTION	TOBACCO USE	TOBACCO YEAR	CURRENT USE	ALCOHOL USE	ALCOHOL YEAR	CURRENT USE	comorbidities
51	Li	65	F	1905402	121	118	6.2	1.26	0	0	0	0	0	0	0	0
52	Sd	32	F	1920604	105	110	6	2.19	0	0	0	0	0	0	0	0
53	Ls	60	M	2121701	108	106	5.9	4	0	0	0	0	0	0	0	1
54	Rc	63	M	2013801	103	103	5.7	2.68	1	1	20	1	0	0	0	1
55	Sj	38	F	2012102	100	108	5.8	5.45	0	0	0	0	0	0	0	0
56	Nf	42	F	2021006	117	122	5.8	5.77	0	0	0	0	0	0	0	0
57	Rh	32	M	2609701	111	104	5.9	4.66	0	0	0	0	0	0	0	0
58	Rs	37	F	2013201	117	121	6.4	2.24	0	0	0	0	0	0	0	0
59	Db	55	F	1917002	124	178	6	3.96	0	0	0	0	0	0	0	0
60	As	60	M	2109401	137	88	6.2	1.8	0	0	0	0	0	0	0	0
61	Aa	42	F	2308102	98	112	5.7	7.52	0	0	0	0	0	0	0	0
62	At	32	M	2112004	118	200	6.3	0.78	1	1	5	0	0	0	0	0
63	Sn	39	F	2320902	100	99	6.2	6.1	0	0	0	0	0	0	0	0
64	Km	37	F	2609802	123	119	5.7	2.4	0	0	0	0	0	0	0	0
65	Sb	40	F	2613602	102	126	5.9	5.33	0	0	0	0	0	0	0	0
66	Kd	43	F	2003902	106	97	5.7	3.23	0	0	0	0	0	0	0	0
67	Km	55	F	2011801	108	113	6	4.44	0	0	0	0	0	0	0	0
68	Kb	60	F	2312502	101	156	6	2.39	0	0	0	0	0	0	0	0
69	Bs	66	M	2312903	105	125	5.8	4.5	1	1	20	1	0	0	0	0
70	Cy	38	F	2119002	103	127	6.2	1.82	0	0	0	0	0	0	0	0
71	Jy	60	F	2307406	115	104	5.8	3.09	0	0	0	0	0	0	0	0
72	Sl	35	F	2617602	136	156	6.3	2.25	0	0	0	0	0	0	0	0
73	Kn	45	F	1900702	114	132	6.3	1.8	0	0	0	0	0	0	0	0
74	Ka	50	F	2313801	112	123	6.4	0.34	0	0	0	0	0	0	0	0
75	Mr	60	F	2314402	111	124	5.9	4.12	0	0	0	0	0	0	0	0
76	Ah	40	F	2304102	109	147	6.2	2.84	0	0	0	0	0	0	0	1
77	Ga	70	F	2106301	120	116	5.8	2.85	1	1	9	0	0	0	1	0
78	Jd	60	M	2112002	117	144	5.91	1.06	0	0	0	0	0	0	0	0
79	Bg	70	M	2324501	106	113	6.2	3.33	0	0	0	0	0	0	0	0
80	Ge	49	F	2308402	107	114	6.1	2.13	0	0	0	0	0	0	0	0
81	Gt	49	F	2610402	103	144	6.3	2.13	0	0	0	0	0	0	0	0
82	Sb	65	F	2323302	120	117	6.4	0.79	1	1	10	1	0	0	0	1
83	Tr	54	M	2323801	111	124	6.4	3.12	0	0	0	0	0	0	0	0
84	Ml	45	F	1916802	115	150	6.2	5.1	0	0	0	0	0	0	0	0
85	Vb	50	F	2103802	123	117	5.91	6.06	1	1	3	1	0	0	0	1
86	Gl	45	M	2122801	114	98	5.8	2.53	0	0	0	0	0	0	0	0
87	Sh	65	M	2613601	132	132	6.2	7.28	0	0	0	0	0	0	0	0
88	Bt	45	M	2319801	112	136	6.3	4.5	0	0	0	0	0	0	0	0
89	bansi b	66	M	2312903	108	121	6.2	4.52	0	0	0	0	0	0	0	0
90	Mahrur	50	F	2014002	113	140	5.7	3.74	0	0	0	0	0	0	0	0
91	Kh	32	M	2315103	119	106	6.1	2.2	0	0	0	0	0	0	0	0
92	Ks	55	F	2613101	115	128	5.8	3.12	0	0	0	0	0	0	0	0
93	Rj	38	M	2607201	108	99	6.4	2.21	0	0	0	0	0	0	0	0
94	St	33	F	2302102	103	136	6.1	2.83	0	0	0	0	0	0	0	0
95	Jr	44	M	2310101	108	143	6.1	1.96	0	0	0	0	0	0	0	0
96	Rb	45	F	2014502	103	160	5.7	5.92	0	0	0	0	0	0	0	0
97	Hk	31	M	2611605	100	109	6.4	1.75	0	0	0	0	0	0	0	0
98	Sv	37	F	2611302	109	106	5.8	4.21	0	0	0	0	0	0	0	0
99	Sh	42	F	2002402	103	102	6.3	3.7	0	0	0	0	0	0	0	0
100	Pv	33 F		2301502	107	163	6.2	2.6	0	0	0	0	0	0	0	0

	NAME	AGE	SEX	UHID	HTN	DURATION YEA	IHD	STROKE	complaints	WEIGHT	HEIGHT	NC	WC	HC	TC	CC	
51	Li	65	F	1905402	0	0	0	0	0	84	154	34	124	96	53	33	
52	Sd	32	F	1920604	0	0	0	0	0	71	166	34	108	94	42	33	
53	Ls	60	M	2121701	1	6	0	0	0	42	157	35	71	81	41	33	
54	Rc	63	M	2013601	1	6	0	0	0	59	166	31	98	93	55	42	
55	Sj	38	F	2012102	0	0	0	0	0	52	152	30	97	87	40	32	
56	Nf	42	F	2021008	0	0	0	0	0	70	152	34	118	110	50	38	
57	Rh	32	M	2608701	0	0	0	0	0	50	146	33	91	87	44	35	
58	Rs	37	F	2013201	0	0	0	0	0	62	164	33	94	90	38	36	
59	Db	55	F	1917002	0	0	0	0	0	49	149	32	99	90	36	30	
60	As	60	M	2109401	0	0	0	0	0	57	168	31	85	89	38	30	
61	Aa	42	F	2308102	0	0	0	0	0	49	147	33	89	86	40	33	
62	Al	32	M	2112004	0	0	0	0	0	62	156	32	95	87	40	30	
63	Sn	39	F	2320902	0	0	0	0	0	52	154	33	86	84	42	34	
64	Km	37	F	2609802	0	0	0	0	0	59	150	34	103	96	40	32	
65	Sb	40	F	2613802	0	0	0	0	0	55	150	34	98	92	37	28	
66	Kd	43	F	2003902	0	0	0	0	0	54	162	32	85	91	40	30	
67	Km	55	F	2011801	0	0	0	0	0	69	167	32	97	85	39	41	
68	Kb	60	F	2312502	0	0	0	0	0	45	150	29	72	85	37	28	
69	Bs	66	M	2312903	0	0	0	0	0	51	159	36	79	89	43	33	
70	Cy	38	F	2119002	0	0	0	0	0	49	147	32	90	98	38	32	
71	Jy	60	F	2307406	0	0	0	0	0	44	150	32	70	82	40	30	
72	St	35	F	2617802	0	0	0	0	0	48	146	35	71	91	41	31	
73	Kn	45	F	1900702	0	0	0	0	1	50	142	33	99	95	35.5	27	
74	Ka	50	F	2313801	0	0	0	0	0	50	142	32	100	95	36	28	
75	Mr	50	F	2311402	0	0	0	0	0	74	164	34	102	96	40	34	
76	Ah	40	F	2304102	1	0	0	0	0	46	152	32	72	84	38	28	
77	Ga	70	F	2106301	0	0	0	0	0	51	146	32	92	88	45	35	
78	Jd	60	M	2112002	0	0	0	0	0	52	164	31	79	85	40	32	
79	Bg	70	M	2324501	0	0	0	0	0	70	162	30	117	96	34	41	
80	Ge	49	F	2308402	0	0	0	0	0	57	159	35	87	89	41	38	
81	Gt	49	F	2610402	0	0	0	0	0	83	155	31	121	100	43	37	
82	Sb	65	F	2323302	1	3	0	0	0	55	153	30	90	98	42	34	
83	Tr	54	M	2323801	0	0	0	0	0	82	161	32	116	97	40	33	
84	Ml	45	F	1916802	0	0	0	0	0	50	154	33	92	90	39	33	
85	Vb	50	F	2103802	1	2	0	0	0	67	161	32	97	105	42	32	
86	Gl	45	M	2122801	0	0	0	0	0	62	164	36	90	89	40	30	
87	Sh	65	M	2613601	0	0	0	0	0	60	145	37	103	93	36	30	
88	Bl	45	M	2319901	0	0	0	0	0	77	158	34	115	99	39	33	
89	barrsl b	66	M	2312903	0	0	0	0	0	79	157	33	114	98	38	34	
90	Mehrur	50	F	2014002	0	0	0	0	0	84	154	33	103	116	46	39	
91	Kh	32	M	2315103	0	0	0	0	0	64	156	31	113	97	37	33	
92	Ks	55	F	2613101	0	0	0	0	0	44	152	33	70	91	48	35	
93	Rj	38	M	2607201	0	0	0	0	0	75	172	43	95	94	43	34	
94	St	33	F	2302102	0	0	0	0	0	62	155	33	88	102	44	35	
95	Jr	44	M	2310101	0	0	0	0	0	55	155	36	90	92	39	34	
96	Rb	45	F	2014502	0	0	0	0	0	68	147	34	117	122	41	34	
97	Hk	31	M	2611606	0	0	0	0	0	75	154	35	119	98	35	36	
98	Sv	37	F	2611302	0	0	0	0	0	48	140	31	99	84	36	28	
99	Sh	42	F	2002402	0	0	0	0	0	81	166	35	108	96	43	37	
100	Pv	33	F	2301502	0	0	0	0	0	58	160	33	92	102	44	34	

	NAME	AGE	SEX	UHID	WHR	WSR	BMI	TBW	FAT	LBM/BAI	SBP	DBP	PR	MAP	PRESCRIPTION	Life style meas
51	Li	65	F	1905402	1.291666667	0.805194805	35.41912633	50.4	78.33883605		134	84	83	100.6666667	1	1
52	Sd	32	F	1920604	1.14893617	0.650602409	25.76571346	42.6	67.94144328		125	86	87	99	1	1
53	Ls	60	M	2121701	0.878543209	0.452229299	17.0392308	25.2	16.75678644		158	96	69	116.6666667	1	1
54	Rc	63	M	2013601	1.053763441	0.590361446	21.41094498	35.4	38.26432329		132	84	96	100	1	1
55	Sj	38	F	2012102	1.114942529	0.638157895	22.50692521	31.2	65.51183757		101	67	62	78.33333333	1	1
56	Nf	42	F	2021008	1.072727273	0.776315789	30.29778393	42	81.87819966		154	70	90	98	1	1
57	Rh	32	M	2609701	1.045977011	0.623287671	23.45655845	30	36.78116771		120	76	76	90.66666667	1	1
58	Rs	37	F	2013201	1.044444444	0.573170732	23.05175491	37.2	60.8698561		128	90	78	102.6666667	1	1
59	Db	55	F	1917002	1.1	0.664429530	22.07107788	29.4	67.72496807		117	72	79	87	1	1
60	As	60	M	2109401	0.955056180	0.509952381	20.19557823	34.2	29.8425219		128	88	87	101.3333333	1	1
61	Aa	42	F	2308102	1.034883721	0.605442177	22.67573696	29.4	61.18066199		116	82	86	83.33333333	1	1
62	At	32	M	2112004	1.091954023	0.608974359	25.47666009	37.2	37.8548379		120	69	82	99.33333333	1	1
63	Sn	39	F	2320902	1.023809524	0.558441558	21.92612582	31.2	56.66645615		112	84	76	93.33333333	1	1
64	Km	37	F	2609802	1.072916667	0.686868687	28.22222222	35.4	70.96387293		128	71	80	90	1	1
65	Sb	40	F	2613602	1.065217391	0.653333333	24.44444444	33	66.98830589		126	72	80	90	1	1
66	Kd	43	F	2003902	0.934065934	0.524691358	20.57613169	32.4	58.0501239		140	74	74	96	1	1
67	Km	55	F	2011801	1.141176471	0.580383234	24.74093729	41.4	59.65402903		123	85	72	97.66666667	1	1
68	Kb	60	F	2312502	0.847058824	0.48	20	27	52.96660891		145	92	100	109.6666667	1	1
69	Bs	66	M	2312903	0.887640449	0.496855346	20.17325264	30.6	23.00676728		122	83	68	96	1	1
70	Cy	38	F	2119002	0.918367347	0.6122449	22.67573696	29.4	67.84534282		130	80	92	96.66666667	1	1
71	Jy	60	F	2307406	0.853658537	0.466666667	19.55555556	26.4	48.39218108		107	65	71	79	1	1
72	St	35	F	2617602	0.780219780	0.486301370	22.51829612	28.8	53.55729933		108	76	77	86.66666667	1	1
73	Kn	45	F	1900702	1.042105263	0.697183099	24.79666733	30	71.54949162		137	71	92	93	1	1
74	Ka	50	M	2313601	1.052631579	0.704225352	24.79666733	30	72.4245525		137	71	92	93	1	1
75	Mr	50	F	2311402	1.0625	0.621951219	27.51338489	44.4	66.74764314		126	81	90	96	1	1
76	Ah	40	F	2304102	0.857142857	0.473684211	19.9099723	27.6	50.1544044		161	93	71	115.6666667	1	1
77	Ga	70	F	2106301	1.045454545	0.630136986	23.92568982	30.6	64.40357631		106	70	90	82	1	1
78	Jd	60	M	2112002	0.929411765	0.481707317	19.33372992	31.2	26.17589571		106	64	83	78	1	1
79	Bg	70	M	2324501	1.21875	0.722222222	26.6727633	42	48.7636193		127	86	82	99.66666667	1	1
80	Ge	49	F	2308402	0.977528090	0.547169811	22.54657648	34.2	57.3508341		127	76	88	93	1	1
81	Gt	49	F	2610402	1.21	0.780845161	34.54734651	49.8	79.57238117		115	78	72	90.33333333	1	1
82	Sb	65	F	2323302	0.918367347	0.588235294	23.49523687	33	67.05117081		139	93	80	108.3333333	1	1
83	Tr	54	M	2323801	1.195876289	0.720496894	31.634582	49.2	47.64117704		129	89	85	102.3333333	1	1
84	Ml	45	F	1916802	1.022222222	0.597402597	21.08281329	30	62.61784092		106	78	88	87.33333333	1	1
85	Vb	50	F	2103802	0.923809524	0.602484472	25.84776822	40.2	70.07766464		127	78	78	94.33333333	1	1
86	Gl	45	M	2122801	1.011235955	0.548780488	23.05175491	37.2	30.57552417		95	63	69	73.66666667	1	1
87	Sh	65	M	2613601	1.107526882	0.710344828	28.53745541	36	41.81675902		138	82	76	100.6666667	1	1
88	Bl	45	M	2319801	1.161616162	0.727848101	30.84441596	46.2	46.8548541		114	82	76	92.66666667	1	1
89	bansi b	66	M	2312903	1.163265306	0.726114649	32.04908174	47.4	47.0478848		123	88	79	99.66666667	1	1
90	Mehrur	50	F	2014002	0.889793103	0.666931169	35.41912633	50.4	78.53883605		114	79	83	90.66666667	1	1
91	Kh	32	M	2315103	1.164948454	0.724359744	26.29848784	38.4	47.70068257		125	83	80	97	1	1
92	Ks	55	F	2613101	0.789230769	0.480526316	19.04432133	26.4	52.40472143		114	63	82	80	1	1
93	Rj	38	M	2607201	1.010638298	0.552325581	25.35154137	45	27.71703516		130	82	70	98	1	1
94	St	33	F	2302102	0.862745098	0.567741935	25.80645161	37.2	66.05020249		113	72	79	85.66666667	1	1
95	Jr	44	M	2310101	0.978260870	0.580645161	22.89281998	33	32.29235514		134	86	81	102	1	1
96	Rb	45	F	2014502	0.959016393	0.795918367	31.46836966	40.8	87.20623164		117	74	96	88.33333333	1	1
97	Hk	31	M	2611605	1.214285714	0.772727273	31.62421904	45	48.99331011		128	83	82	98	1	1
98	Sv	37	F	2611302	1.178571429	0.707142857	24.48979592	28.8	68.07396625		144	77	89	99.33333333	1	1
99	Sh	42	F	2002402	1.125	0.650602409	28.39468718	48.6	68.36209159		116	82	82	93.33333333	1	1
100	Pv	33 F		2301502	0.901960784	0.575	22.65625	34.8	66.48657719		133	99	93	110.3333333	1	1

	NAME	AGE	SEX	UHID	Metformin	OTHER	Thyroxine		FU_BS	FU_HbA1c	FU_TSH	FU_WEIGHT	FU_HEIGHT	FU_NC	FU_WC	FU_HC
51	Li	65	F	1905402	0	0	0									
52	Sd	32	F	1920604	0	0	0									
53	Ls	60	M	2121701	0	1	0									
54	Rc	63	M	2013601	0	0	0									
55	Sj	38	F	2012102	0	0	0									
56	Nf	42	F	2021008	0	0	1									
57	Rh	32	M	2609701	0	0	0		129	5.7	2.19	52	146	33	93	88
58	Rs	37	F	2013201	0	0	0									
59	Db	55	F	1917002	0	0	0									
60	As	60	M	2109401	0	0	0		130	5.2	1.83	58	168	31	87	90
61	Aa	42	F	2308102	0	0	0									
62	Al	32	M	2112004	0	0	0									
63	Sn	39	F	2320902	0	0	0									
64	Km	37	F	2609802	0	0	0									
65	Sb	40	F	2613602	0	0	0									
66	Kd	43	F	2003902	0	0	0									
67	Km	55	F	2011801	0	0	0									
68	Kb	60	F	2312502	0	0	0									
69	Bs	66	M	2312903	0	1	0									
70	Cy	38	F	2119002	0	0	0									
71	Jy	60	F	2307406	0	0	0									
72	St	35	F	2617602	0	0	0									
73	Kn	45	F	1907702	1	0	0									
74	Ka	50	F	2313601	1	0	0									
75	Mr	50	F	2311402	0	0	0									
76	Ah	40	F	2304102	0	0	0									
77	Ga	70	F	2106301	0	0	0		114	4.7	1.2	49	146	32	89	87
78	Jd	60	M	2112002	0	0	0									
79	Bg	70	M	2324501	0	0	0									
80	Ge	49	F	2308402	0	0	0									
81	Gt	49	F	2610402	0	0	0		109	5.4	3.04	84	155	32	120	100
82	Sb	65	F	2323302	0	0	0									
83	Tr	54	M	2323801	0	0	0									
84	Ml	45	F	1916602	0	0	0									
85	Yb	50	F	2103802	0	0	0									
86	Gl	45	M	2122801	0	0	0									
87	Sh	65	M	2613601	0	0	0		120	5.7	2.93	62	145	37	104	94
88	Bt	45	M	2319801	0	0	0									
89	bansi b	66	M	2312903	0	0	0									
90	Mehrur	50	F	2014002	0	0	0		105	6.4	2.6	84	154	33	103	115
91	Kh	32	M	2315103	0	0	0									
92	Ks	55	F	2613101	0	0	0									
93	Rj	38	M	2607201	0	0	0									
94	St	33	F	2302102	0	1	0									
95	Jr	44	M	2310101	0	0	0									
96	Rb	45	F	2014502	0	0	0									
97	Hk	31	M	2616605	0	0	0		94	5.91	1.18	73	154	35	117	120
98	Sv	37	F	2611302	0	0	0		90	5.4	2.86	49	140	31	100	86
99	Sh	42	F	2002402	0	0	0									
100	Pv	33	F	2301502	0	0	0									

	NAME	AGE	SEX	UHID	FU_TC	FU_CC	FU_BMI	FU_SBP	FU_DBP	FU_PR	FU MAP		2FUP RBS	2FUP HBA1C	2FUP TSH	SBP
51	Li	65	F	1905402									103	5.2	2.88	126
52	Sd	32	F	1920604									113	5.4	6.75	128
53	Ls	60	M	2121701									106	5.6	0.96	143
54	Rc	63	M	2013601									99	4.9	0.1	128
55	Sj	38	F	2012102									121	5.3	0.21	131
56	Nf	42	F	2021008									106	5.3	2.66	123
57	Rh	32	M	2609701	44	35	24.39482079	120	83	82	96.33333333		127	5.2	2.28	134
58	Rs	37	F	2013201									126	5.3	0.68	127
59	Db	55	F	1917002									111	5.4	2.7	130
60	As	60	M	2109401	37	30	20.54988662	124	84	85	97.33333333		91	4.8	3.41	156
61	As	42	F	2309102									150	5.2	2.92	119
62	At	32	M	2112004									89	4.9	1.5	133
63	Sn	39	F	2320902									121	5.6	6	128
64	Km	37	F	2609802									128	5.1	0.64	124
65	Sb	40	F	2613602									131	5.3	3.92	130
66	Kd	43	F	2003902									110	5.5	2.6	128
67	Km	55	F	2011801												
68	Kb	60	F	2312502									106	5.6	0.96	123
69	Bs	66	M	2312903												
70	Cy	38	F	2119002									113	5.2	0.66	129
71	Jy	60	F	2307406												
72	St	35	F	2617602									106	5	1.22	130
73	Kn	45	F	1900702									90	4.9	3.38	140
74	Ka	50	F	2313601									157	5.4	0.76	135
75	Mr	50	F	2311402									95	5.1	1.85	122
76	Ah	40	F	2304102									117	5.4	4.97	138
77	Ga	70	F	2106301	42	34	22.98742728	112	82	86	92		116	5.5	0.69	134
78	Jd	60	M	2112002												
79	Bg	70	M	2324501												
80	Ge	49	F	2309402									117	5.2	0.48	128
81	Gt	49	F	2610402	40	37	34.9635795	123	77	85	92.33333333		108	5.3	3.82	127
82	Sb	65	F	2323302									135	5.3	6.74	122
83	Tr	54	M	2323801									108	5.3	3.82	145
84	Ml	45	F	1916802									135	5.2	3.45	140
85	Vb	50	F	2103802									77	5.5	2.65	132
86	Gl	45	M	2122801									153	5	8.7	127
87	Sh	65	M	2613501	38	30	29.46870392	130	82	86	98		99	4.8	2.88	131
88	Bt	45	M	2319801									131	5.3	0.81	129
89	bansi b	66	M	2312903									147	5.3	2.18	133
90	Mehrur	50	F	2014002	45	38	35.41912633	129	83	87	98.33333333		147	6.3	3.52	123
91	Kh	32	M	2315103									133	5.6	3.9	118
92	Ks	55	F	2613101									95	5.3	3.55	129
93	Rj	38	M	2607201									199	5.3	4.22	115
94	Sl	33	F	2302102									116	5.5	0.82	119
95	Jr	44	M	2310101									110	4.8	2.11	127
96	Rb	45	F	2014502												
97	Hk	31	M	2611605	44	34	30.7899074	131	84	89	99.66666667		129	4.8	2.12	112
98	Sv	37	F	2611302	36	30	25	127	82	90	97		128	5	2.89	130
99	Sh	42	F	2002402									177	5.3	3.01	131
100	Pv	33 F		2301502									127	5.1	0.45	122

	NAME	AGE	SEX	UHID	DBP	PR	2-MAP	WT	HT	NC	WC	HC	TC	CC	2-FU BMI
51	Li	65	F	1905402	78	80	94	84	154	24	123	97	52	35	35.41912633
52	Sd	32	F	1920604	89	69	102	72.5	166	34	109	96	42	34	26.31005952
53	Ls	60	M	2121701	84	72	103.6666667	43	157	34	73	82	40	33	17.44492677
54	Rc	63	M	2013601	78	86	94.66666667	56	166	31	95	91	52	39	20.32225287
55	Sj	38	F	2012102	80	82	97	51	152	30	94.5	86	40	32.5	22.07409072
56	Nf	42	F	2021008	86	90	98.33333333	70	152	34	117	111	49	39	30.29778393
57	Rh	32	M	2609701	84	88	100.6666667	52	146	33	93	89	40	33	24.39482079
58	Rs	37	F	2013201	86	79	99.66666667	60	164	33	91	88	38	32	22.30814991
59	Db	55	F	1917002	92	83	104.6666667	50	149	32	100	92	38	31	22.52150804
60	As	60	M	2109401	100	90	118.6666667	57	168	31	86	90	36	30	20.19557823
61	Aa	42	F	2308102	78	81	91.66666667	49	147	33	89	87	41	33	22.67573696
62	At	32	M	2112004	82	87	99	59	156	32	93	85	38	31	24.24391647
63	Sn	39	F	2320902	84	83	98.66666667	53.5	154	33	88	85	43	35	22.65861022
64	Km	37	F	2609802	87	90	99.33333333	57	150	34	101	94	39	32.5	25.33333333
65	Sb	40	F	2613602	86	89	100.6666667	56	150	34	99	94	41	33	24.88888889
66	Kd	43	F	2003902	80	87	96	53	162	32	84	89	39	30	20.19509221
67	Km	55	F	2011801											
68	Kb	60	F	2312502	79	89	93.66666667	45.5	150	29	73	85	38	28	20.22222222
69	Bs	66	M	2312903											
70	Cy	38	F	2119002	82	90	97.66666667	47	147	32	89	96	37	31	21.75019668
71	Jy	60	F	2307406											
72	St	35	F	2617602	81	88	97.33333333	48	146	34.5	72	90	41	32	22.51829612
73	Kn	45	F	1907702	84	87	102.6666667	51	142	32	100	95	38	28	25.29280067
74	Ka	50	F	2313601	88	84	103.6666667	49	142	32	98	93	35	27	24.30073398
75	Mr	50	F	2311402	84	80	96.66666667	72	164	34	99	94.5	40	35	26.76977989
76	Ah	40	F	2304102	82	76	100.6666667	45.5	152	32	73	84	38	29	19.69355956
77	Ga	70	F	2106301	86	81	102	50	146	32	90	88	43	34	23.45655845
78	Jd	60	M	2112002											
79	Bg	70	M	2324501											
80	Ge	49	F	2308402	60	78	82.66666667	55	159	35	85	87	40	36	21.75546853
81	Gt	49	F	2610402	72	80	90.33333333	84	155	32	116	120	44	36	34.9635796
82	Sb	65	F	2323302	81	73	94.66666667	56.6	153	30	95	100	42	35	24.17873467
83	Tr	54	M	2323801	98	79	113.6666667	81	161	32	113	96	40	33	31.24879441
84	Ml	45	F	1916802	90	84	106.6666667	52.4	154	33	94	92	41	33.5	22.09478833
85	Vb	50	F	2103602	88	85	102.6666667	65	161	32	95	103	41	32	25.07619305
86	Gl	45	M	2122601	89	87	101.0666667	65	164	36	93	91	40	33	24.1671624
87	Sh	65	M	2613601	92	89	105	62	145	36	105	94	38	30	29.48870392
88	Bt	45	M	2319601	86	90	100.3333333	75.6	158	34	113	98	38	32	30.2836084
89	bansi b	66	M	2312903	88	79	103	79	157	33	114	99	39	33	32.04998174
90	Mehrur	50	F	2014002	90	82	101	86	154	33	106	117	45	38	36.26243886
91	Kh	32	M	2315103	68	77	84.66666667	63	156	31	111	96	37	32.5	25.58757396
92	Ks	55	F	2613101	89	82	102.3333333	43	152	33	70	89	42	34	18.61149684
93	Rj	38	M	2607201	82	90	93	78	172	43	98	96	44	35	26.36560303
94	St	33	F	2302102	84	87	95.66666667	60	155	33	86.5	100	42	33	24.97385543
95	Jr	44	M	2310101	86	88	99.66666667	54.5	155	36	90	92	39	34	22.68470343
96	Rb	45	F	2014502											
97	Hk	31	M	2611605	67	84	82	73	154	35	116	120	40	36	30.7809074
98	Sv	37	F	2611302	80	74	96.66666667	50	140	32	98	88	36	30	25.51020408
99	Sh	42	F	2002402	83	78	99	83.4	166	35	110	98	44	38	30.26564088
100	Pv	33 F		2301502	84	79	96.66666667	56	160	33	90	100	42.5	34	21.875

	NAME	AGE	SEX	UHID	FBS	CAMP SUGAR	HBA1c	TSH	ADDICTION	TOBACCO USE	TOBACCO YEAR	CURRENT USE	ALCOHOL USE	ALCOHOL YEAR	CURRENT USE	comorbidities
101	Kr	50	F	2307702	106	127	6.3	3.82	0	0	0	0	0	0	0	0
102	Rk	36	F	2612705	102	136	5.8	2.56	0	0	0	0	0	0	0	1
103	Parvati	47	M	2621701	107	150	6.2	1.09	1	0	0	0	1	7	1	0
104	St	32	F	2624302	102	124	5.8	3.41	0	0	0	0	0	0	0	0
105	Ib	60	F	1913101	127	112	6.3	1.96	0	0	0	0	0	0	0	0
106	Fd	54	F	1920802	109	109	5.7	3.74	0	0	0	0	0	0	0	1
107	Mh	40	F	1909202	118	180	6.4	2.83 1		1	1	1	0	0	0	1
108	Ky	38	M	2108701	104	106	5.8	2.68	0	0	0	0	0	0	0	0
109	Nk	65	F	2122702	113	133	6.4	1.72	1	1	11	1	0	0	0	0
110	Pt	65 M		2302801	108	139	6.2	3.72	1	1	12	1	1	5	1	1
111	Rd	45	F	1917502	105	115	5.7	5.35	0	0	0	0	0	0	0	0
112	Dt	55	F	1914002	124	130	5.7	3.12	0	0	0	0	0	0	0	0
113	Rn	32	F	2302804	100	133	5.7	3.3	0	0	0	0	0	0	0	0
114	Dr	60	M	2119201	99	138	6.3	3.19	0	0	0	0	0	0	0	0
115	Km	38	M	2119307	113	133	6.4	1.13	0	0	0	0	0	0	0	0
116	Lx	60	F	2119202	92	117	6.3	1.02	0	0	0	0	0	0	0	1
117	Sp	45	M	2118301	109	123	6.1	2.86	0	0	0	0	0	0	0	0
118	Vj	38	M	1906201	106	100	5.8	1.48	1	1	10	1	0	0	0	0
119	At	44	F	2111302	106	163	6.3	3.41	0	0	0	0	0	0	0	0
120	Ru	38	M	1917801	118	130	5.7	2.92	1	0	0	0	1	20	0	0
121	Sl	60	F	2100902	113	134	6.1	3.01	0	0	0	0	0	0	0	0
122	Gn	38	F	2317801	104	124	6.3	1.08	0	0	0	0	0	0	0	0
123	Bb	55	F	2109402	96	132	6.1	1.7	0	0	0	0	0	0	0	0
124	Rb	58	F	2114302	101	154	6.23	2.36	0	0	0	0	0	0	0	0
125	Rt	41	M	1904002	115	150	6.3	1.27	1	1	20	1	1	20	1	1
126	Rd	44	M	2605801	106	114	6.2	1.05	0	0	0	0	0	0	0	0
127	Sl	40	F	2022304	111	116	5.9	6.48	0	0	0	0	0	0	0	0
128	At	38	F	2023002	105	85	5.7	1.13	0	0	0	0	0	0	0	0
129	Rj	70	M	2111001	113	106	5.9	3.26	0	0	0	0	0	0	0	0
130	Rh	45	F	2613202	120	131	5.7	3.49	0	0	0	0	0	0	0	0
131	Ml	54	F	2103002	112	94	6.3	2.37	0	0	0	0	0	0	0	0
132	Sk	37	F	2106802	107	109	6.2	3.06	0	0	0	0	0	0	0	0
133	Sh	50	M	2306001	101	109	6.3	1.02	1	1	10	1	1	8	1	1
134	Sv	35	F	2011902	102	139	5.8	3.06	0	0	0	0	0	0	0	0
135	Rm	50	F	2520802	127	159	5.9	6.97	0	0	0	0	0	0	0	1
136	An	44	F	1606102	102	109	5.7	4.45	0	0	0	0	0	0	0	0
137	Pr	34	F	2312504	105	154	6.1	2.97	0	0	0	0	0	0	0	0
138	Ca	50	F	2020301	116	148	5.8	2.44	0	0	0	0	0	0	0	0
139	Rl	35	M	2117603	117	107	6.4	2.73	0	0	0	0	0	0	0	0
140	Nu	33	M	2700503	106	112	6.2	3.7	0	0	0	0	0	0	0	0
141	Ps	38	M	2302902	107	124	5.8	2.74	0	0	0	0	0	0	0	1
142	Ak	43	M	2316601	108	137	6.1	5.47	1	0	0	0	1	4	1	1
143	Ru	35	M	2117603	117	109	6.4	2.73	0	0	0	0	0	0	0	0
144	Ad	49	M	2316001	110	120	6.4	4.43	0	0	0	0	0	0	0	1
145	Dl	45	M	2320901	109	141	5.9	2.07	0	0	0	0	0	0	0	1
146	Rd	85	M	2100701	125	156	6.2	10.68	1	1	15	1	0	0	0	1
147	Ak	75	M	2112001	120	103	6.3	0.78	0	0	0	0	0	0	0	0
148	Mj	32	M	2323001	116	136	6.4	0.9	0	0	0	0	0	0	0	0

	NAME	AGE	SEX	UHID	HTN	DURATION YEARS	IHD	STROKE	complaints	WEIGHT	HEIGHT	NC	WC	HC	TC	CC	
101	Kr	50	F	2307702	0	0	0	0	0	56	155	32	92	96	42	33	
102	Rk	36	F	2612705	1	1	0	0	0	56	146	31	97	98	33	30	
103	Parvati	47	M	2621701	0	0	0	0	0	50	147	31	101	90	45	34	
104	St	32	F	2624302	0	0	0	0	0	47	148	31	73	92	39	32	
105	Ib	60	F	1913101	0	0	0	0	0	49	153	30	92	79	46	32	
106	Fd	54	F	1920802	1	5	0	0	0	87	157	36	116	97	44	36	
107	Mh	40	F	1909202	1	2	0	0	0	50	157	33	93	95	40	31	
108	Ky	38	M	2108701	0	0	0	0	0	57	167	37	87	96	40	34	
109	Nk	65	F	2122702	0	0	0	0	0	48	150	30	94	83	39	31	
110	Pt	65 M		2302801	1	2	0	0	0	78	156	40	122	104	44	36	
111	Rd	45	F	1917502	0	0	0	0	0	47	165	31	79	83	43	36	
112	Dt	55	F	1914002	0	0	0	0	0	55	152	31	87	78	46	31	
113	Rn	32	F	2302804	0	0	0	0	0	67	160	33	76	88	44	39	
114	Dr	60	M	2119201	0	0	0	0	0	52	150	34	98	92	36	32	
115	Km	38	M	2119307	0	0	0	0	0	53	149	32	101	99	45	35	
116	Lx	60	F	2119202	1	5	0	0	0	50	150	30	85	87	42	36	
117	Sp	45	M	2118301	0	0	0	0	0	54	148	33	110	100	35	34	
118	Vj	38	M	1906201	0	0	0	0	0	58	164	37	91	83	46	37	
119	Al	44	F	2111302	0	0	0	0	1	55	156	31	80	90	38	32	
120	Ru	38	M	1917801	0	0	0	0	0	73	163	39	105	102	46	33	
121	Sl	60	F	2100902	0	0	0	0	0	77	148	31	100	115	44	36	
122	Gn	38	F	2317801	0	0	0	0	0	72	152	38	97	107	48	39	
123	Bb	55	F	2109402	0	0	0	0	0	57	145	30	90	94	42	32	
124	Rb	58	F	2114302	0	0	0	0	0	48	160	28	64	80	38	30	
125	Ri	41	M	1904002	1	3	0	0	0	76	160	39	109	98	41	39	
126	Rd	44	M	2605801	0	0	0	0	0	85	149	39	111	105	46	36	
127	Sl	40	F	2022304	0	0	0	0	0	51	152	32	79	89	44	35	
128	Al	38	F	2023002	0	0	0	0	0	50	168	34	81	87	42	32	
129	Rj	70	M	2111001	0	0	0	0	0	80	147	36	109	101	35	33	
130	Rh	45	F	2613202	0	0	0	0	0	64	147	34	89	98	39	32	
131	Ml	54	F	2103002	0	0	0	0	0	47	161	30	70	83	40	32	
132	Sk	37	F	2106802	0	0	0	0	0	42	157	29	62	75	38	32	
133	Sh	50	M	2308001	1	2	0	0	0	63	163	38	97	92	40	33	
134	Sv	35	F	2011902	0	0	0	0	0	48	167	31	84	87	48	41	
135	Rm	50	F	2520802	1	2	0	0	0	56	161	32	82	83	39	31	
136	An	44	F	1606102	0	0	0	0	0	58	156	33	91	88	37	35	
137	Pr	34	F	2312504	0	0	0	0	0	48	155	39	86	88	39	29	
138	Ca	50	F	2020301	0	0	0	0	0	50	145	31	90	130	43	38	
139	Rl	35	M	2117603	0	0	0	0	0	52	155	38	88	92	40	30	
140	Nu	33	M	2700503	0	0	0	0	0	45	149	34	98	93	36	32	
141	Ps	38	M	2302902	1	4	0	0	0	74	169	40	100	96	45	35	
142	Ak	43	M	2316601	1	1	0	0	0	78	155	38	105	107	46	38	
143	Ru	35	M	2117603	0	0	0	0	0	57	157	38	94	92	40	30	
144	Ad	49	M	2316001	1	2	0	0	0	70	157	38	98	101	48	40	
145	Dl	45	M	2320901	1	1	0	0	0	64	160	38	93	90	38	32	
146	Rd	85	M	2100701	1	10	0	0	1	62	161	38	95	93	40	33	
147	Ak	75	M	2112001	0	0	0	0	0	53	153	35	82	93	46	34	
148	Mj	32	M	2323001	0	0	0	0	0	75	162	36	104	92	44	31	

	NAME	AGE	SEX	UHID	WHR	WSR	BMI	TBW	FAT	LBM/BAI	SBP	DBP	PR	MAP	PRESCRIPTION	Life style meas
101	Kr	50	F	2307702	0.9583333333	0.5935483871	23.30905307	33.6	65.5972998		119	75	79	89.66666667	1	1
102	Rk	36	F	2612705	0.9697969184	0.6643835616	28.27134647	33.6	71.67960327		163	87	82	112.3333333	1	1
103	Parvati	47	M	2621701	1.122222222	0.687074829	23.1386071	30	43.5979763		103	67	80	79	1	1
104	Sl	32	F	2624302	0.7934782609	0.4932432432	21.45726808	28.2	56.78297426		122	82	72	95.33333333	1	1
105	Ib	60	F	1913101	1.164556962	0.6013071895	20.93212012	29.4	58.98284632		130	86	86	100.6666667	1	1
106	Fd	54	F	1920802	0.9756756269	0.7368535032	35.29554852	52.2	74.00499689		112	78	86	89.33333333	1	1
107	Mh	40	F	1909202	0.9789473684	0.5923566879	20.28479857	30	64.59706675		131	86	84	101	1	1
108	Ky	38	M	2108701	0.90625	0.5209380838	20.43816558	34.2	27.14934843		120	70	82	86.66666667	1	1
109	Nk	65	F	2122702	1.13253012	0.6266666667	21.33333333	28.8	62.77643143		92	63	89	72.66666667	1	1
110	Pt	65 M		2302801	1.173076923	0.7820512821	32.05128205	46.8	47.70068257		134	67	79	89.33333333	1	1
111	Rd	45	F	1917502	0.9518072289	0.4787878788	17.26354454	28.2	50.56543014		125	79	80	94.33333333	1	1
112	Db	55	F	1914002	1.115384615	0.5729684211	23.80540166	33	55.65165695		127	80	80	95.66666667	1	1
113	Rn	32	F	2302804	0.8838383636	0.475	26.1718 75	40.2	51.8708219		132	78	92	96	1	1
114	Dr	60	M	2119201	1.066217391	0.6533333333	23.11111111	31.2	39.63610778		130	84	86	99.33333333	1	1
115	Km	38	M	2119307	1.020202020	0.677852349	23.87279852	31.8	42.64944405		129	84	80	99	1	1
116	Lx	60	F	2119202	0.9770114943	0.5666666667	22.22222222	30	60.32362506		144	83	79	103.3333333	1	1
117	Sp	45	M	2118301	1.1	0.7432432432	24.65303141	32.4	46.85193673		117	79	77	91.66666667	1	1
118	Vj	38	M	1906201	1.096385542	0.5548780488	21.56454491	34.8	30.57552417		115	75	76	88.33333333	1	1
119	At	44	F	2111302	0.8888888889	0.5128205128	22.60026298	33	57.14631971		138	87	84	104	1	1
120	Ru	38	M	1917801	1.029411765	0.6441177191	27.47562949	43.8	38.25735408		150	80	77	103.3333333	1	1
121	Sl	60	F	2100902	0.8695652174	0.6756756757	35.15339664	46.2	79.25842944		152	75	85	100.6666667	1	1
122	Gn	38	F	2317801	0.9066420561	0.6381578947	31.1634349	43.2	70.83026884		113	67	79	82.33333333	1	1
123	Bb	55	F	2109402	0.9574468085	0.6206896552	27.11058264	34.2	67.51189279		116	82	89	93.33333333	1	1
124	Rb	58	F	2114302	0.8	0.4	18.75	28.8	43.25142623		128	81	81	96.66666667	1	1
125	Rl	41	M	1904002	1.112244898	0.68125	29.6875	45.6	41.02031884		131	78	81	95.66666667	1	1
126	Rd	44	M	2605801	1.057142857	0.7449664443	38.28656367	51	44.23920178		129	81	89	97	1	1
127	Sl	40	F	2022304	0.8876404494	0.5197368421	22.07409972	30.6	56.70173587		126	81	78	96	1	1
128	At	38	F	2023002	0.9310344828	0.4821428571	17.7154195	30	51.40592798		104	69	84	80.66666667	1	1
129	Rj	70	M	2111001	1.079207921	0.7414965986	37.02161137	48	45.16549307		124	81	76	95.33333333	1	1
130	Rh	45	F	2613202	0.9081632653	0.6054421769	29.61728809	38.4	66.46900771		132	79	82	96.66666667	1	1
131	Ml	54	F	2103002	0.843373494	0.4347826087	18.13201651	28.2	47.14021214		101	64	76	76.33333333	1	1
132	Sk	37	F	2106802	0.8266666667	0.3949044586	17.0392308	25.2	38.98944597		101	76	85	84.33333333	1	1
133	Sh	50	M	2308001	1.054347826	0.5950920245	23.71184463	37.8	34.06936171		169	83	64	111.6666667	1	1
134	Sv	35	F	2011902	0.9655172414	0.502994012	17.21108681	28.8	54.76388116		122	82	89	95.33333333	1	1
135	Rm	50	F	2520802	0.9875618072	0.5093167702	21.60410478	33.6	52.68045549		164	110	75	134.6666667	1	1
136	An	44	F	1606102	1.034090909	0.5833333333	23.8330046	34.8	60.62879706		129	81	79	97	1	1
137	Pr	34	F	2312504	0.9772727273	0.5548387097	19.97918835	28.8	55.34952241		114	76	66	88.66666667	1	1
138	Ca	50	F	2020301	0.6923076923	0.6206896552	23.78121284	30	82.02752229		128	84	74	98.66666667	1	1
139	Rl	35	M	2117603	0.9665217391	0.5677419355	21.64412071	31.2	29.41757793		132	98	79	109.3333333	1	1
140	Nu	33	M	2700503	1.053763441	0.6577181208	20.26935724	27	39.83957332		126	82	88	96.66666667	1	1
141	Ps	38	M	2302902	1.041666667	0.5917159763	25.90945695	44.4	33.59760425		109	66	80	80.33333333	1	1
142	Ak	43	M	2316601	0.9813084112	0.6774193548	32.46518106	46.8	40.34986164		122	80	65	94	1	1
143	Ru	35	M	2117603	1.02173913	0.5987261146	23.1246 7037	34.2	33.26084055		137	98	79	111	1	1
144	Ad	49	M	2316001	0.9702970297	0.6242038217	28.398718	42	35.83797739		134	87	88	102.6666667	1	1
145	Dl	45	M	2320901	1.033333333	0.58125	25	38.4	32.01203134		157	94	81	115	1	1
146	Rd	85	M	2100701	1.021505376	0.5900621118	23.91883029	37.2	33.15671198		175	71	66	105.6666667	1	1
147	Ak	75	M	2112001	0.8817204301	0.5359477124	22.64086462	31.8	27.50134895		157	74	82	101.6666667	1	1
148	Mj	32	M	2323001	1.130434783	0.6419753086	28.57796068	45	39.55965996		120	80	87	93.33333333	1	1

	NAME	AGE	SEX	UHID	Metformin	OTHER	Thyroxine		FU_BS	FU_HbA1c	FU_TSH	FU_WEIGHT	FU_HEIGHT	FU_NC	FU_WC	FU_HC
101	Kr	50	F	2307702	0	0	0									
102	Rk	36	F	2612705	0	1	0		86	5.37	2.84	55	146	31	96	97
103	Parvati	47	M	2621701	0	0	0									
104	St	32	F	2624302	0	0	0									
105	Ib	60	F	1913101	0	0	0									
106	Fd	54	F	1920802	0	0	0									
107	Mh	40	F	1909202	1	0	0									
108	Ky	38	M	2108701	0	0	0		118	5.7	0.94	55	167	36	87	95
109	Nk	65	F	2122702	0	0	0									
110	Pt	65 M		2302801	1	0	0									
111	Rd	45	F	1917502	0	0	0									
112	Dt	55	F	1914002	0	0	0									
113	Rn	32	F	2302804	0	0	0									
114	Dr	60	M	2119201	0	0	0		98	5.2	3.15	52	150	34	99	93
115	Km	38	M	2119307	0	0	0									
116	Lx	60	F	2119202	0	1	0									
117	Sp	45	M	2118301	0	0	0		102	5.8	2.7	53	148	33	108	99
118	Vj	38	M	1906201	0	0	0									
119	At	44	F	2111302	1	0	0		132	6.8	2.28	54	156	31	82	90
120	Ru	38	M	1917801	0	0	0									
121	Si	60	F	2100902	0	0	0		253	11.3	1.42	79	148	32	104	116
122	Gn	38	F	2317801	0	0	0									
123	Bb	55	F	2109402	0	0	0		121	5.2	2.34	56	145	31	89	92
124	Rb	58	F	2114302	0	0	0		322	6.9	5.8	50	160	29	68	80
125	Rt	41	M	1904002	1	0	0									
126	Rd	44	M	2605801	0	0	0		147	6.3	3.52	86	149	38	110	99
127	Sl	40	F	2022304	0	0	0									
128	At	38	F	2023002	0	0	0					42	157	30	62	75
129	Rj	70	M	2111001	0	0	0									
130	Rh	45	F	2613202	0	0	0									
131	Ml	54	F	2103002	0	0	0									
132	Sk	37	F	2106802	0	0	0		87	4.9	2.39					
133	Sh	50	M	2308001	0	0	0					53	155	38	98	92
134	Sv	35	F	2011902	0	0	0									
135	Rm	50	F	2520802	0	1	0									
136	An	44	F	1606102	0	0	0									
137	Pr	34	F	2312504	0	0	0									
138	Ca	50	F	2020301	0	0	0									
139	Rl	35	M	2117603	0	0	0		143	6.4	3.7					
140	Nu	33	M	2700503	0	0	0		86	4.8	1.69	45	149	34	98	93
141	Ps	38	M	2302902	1	0	0					58	157	38	96	93
142	Ak	43	M	2316801	0	0	0									
143	Ru	35	M	2117603	0	0	0		143	6.4	3.7					
144	Ad	49	M	2316001	1	0	0					61	161	37	95	92
145	Dl	45	M	2320901	0	1	0									
146	Rd	85	M	2100701	0	1	1		182	4.7	9.4					
147	Ak	75	M	2112001	0	0	0									
148	Mj	32	M	2323001	0	0	0									

	NAME	AGE	SEX	UHID	FU_TC	FU_CC	FU_BMI	FU_SBP	FU_DBP	FU_PR	FU MAP		2FUP RBS	2FUP HBA1C	2FUP TSH	SBP
101	Kr	50	F	2307702									124	5.3	0.46	134
102	Rk	36	F	2612705	32	28	25.8022143	148	93	92	111.3333333		118	5.4	0.42	136
103	Parvati	47	M	2621701												
104	St	32	F	2624302									109	5.2	0.67	127
105	Ib	60	F	1913101												
106	Fd	54	F	1920802									129	5.3	5.05	128
107	Mh	40	F	1909202									99	5.3	5.05	124
108	Ky	38	M	2108701	38	31	19.72103697	125	85	84	98.33333333		121	5.6	0.45	133
109	Nk	65	F	2122702									105	5.3	5.13	119
110	Pt	65	M	2302801									96	4.7	3.49	120
111	Rd	45	F	1917502									99	4.5	4.48	124
112	Dt	55	F	1914002												
113	Rn	32	F	2302804									98	4.9	5.3	
114	Dr	60	M	2119201	36	32	23.11111111	133	79	85	97		109	5.5	3	119
115	Km	38	M	2119307									91	5.2	0.82	124
116	Lx	60	F	2119202									115	5	3.13	121
117	Sb	45	M	2118301	35	32	24.19648379	118	82	86	94		157	5.6	2.9	133
118	Vj	38	M	1906201									105	5.3	2	132
119	At	44	F	2111302	37	31	22.16934911	124	81	89	95.33333333		108	5.4	1.72	154
120	Ru	38	M	1917801									119	4.7	4.98	127
121	Si	60	F	2100902	44	36	36.06647168	117	82	91	93.66666667		109	4.8	8.05	125
122	Gn	38	F	2317801									135	5.1	3.55	119
123	Bb	55	F	2109402	40	32	26.63495838	121	86	79	97.66666667		208	5.5	4.26	122
124	Rb	58	F	2114302	38	30	19.53125	119	71	78	87		112	6.2	1.77	116
125	Rt	41	M	1904002									112	6	0.44	128
126	Rd	44	M	2605801	42	39	38.73699383	123	82	83	95.66666667		151	5	5.54	156
127	Sl	40	F	2022304												
128	At	38	F	2023002	38	32	17.0392308	128	86	90	100		125	5.8	1.56	131
129	Rj	70	M	2111001												
130	Rh	45	F	2613202												
131	Ml	54	F	2103002									109	5.5	1.12	132
132	Sk	37	F	2106802									130	5.1	2.2	122
133	Sh	50	M	2308001	40	32	22.0603538	130	89	92	102.6666667		150	5.4	1.12	136
134	Sv	35	F	2011902									105	5.1	0.46	157
135	Rm	50	F	2520802												
136	An	44	F	1606102									101	5.3	0.17	146
137	Pr	34	F	2312504												
138	Ca	50	F	2020301									101	6	1.26	130
139	Rl	35	M	2117603									105	5.3	2.65	119
140	Nu	33	M	2700503	36	32	20.26935724	127	84	85	98.33333333		109	5.7	3.6	132
141	Ps	38	M	2302902	40	31	23.53036834	130	83	82	98.66666667		112	6.2	4.52	128
142	Ak	43	M	2316601									105	5.1	0.65	133
143	Ru	35	M	2117603												
144	Ad	49	M	2316001	40	32	23.53304271	154	94	84	114					
145	Dl	45	M	2320901												
146	Rd	85	M	2100701												
147	Ak	75	M	2112001									100	5.3	0.69	162
148	Mj	32	M	2323001												

	NAME	AGE	SEX	UHID	DBP	PR	2-MAP	WT	HT	NC	WC	HC	TC	CC	2-FU BMI
101	Kr	50	F	2307702	89	82	104	55	155	32	90	95	42	33	22.89281988
102	Rk	36	F	2617705	92	85	106.6666667	55	146	31	96	96	32	28	25.8022143
103	Parvati	47	M	2621701											
104	St	32	F	2624302	86	80	99.66666667	48.5	147	31	72	90	38	32	22.44435189
105	Ib	60	F	1913101											
106	Fd	54	F	1920802	89	79	102	88	157	36	118	98	44	37	35.70124549
107	Mh	40	F	1909202	77	82	92.66666667	50	157	33	94	96	40	31	20.28479857
108	Ky	38	M	2108701	86	84	101.6666667	51	167	34	85	92	36	30	18.28677973
109	Nk	65	F	2122702	83	86	95	48	150	30	93	85	39	31.5	21.33333333
		65 M		2302801	84	88	96	76	156	40	119	103	43	34	31.22945431
110	Pt	45	F	1917502	87	90	99.33333333	47	165	31	79	83	39	31	17.28354454
111	Rd	55	F	1914002											
112	Dt	32	F	2302804	78	84	89.66666667	67	160	33	78	89	44	36	26.171875
113	Rn	60	M	2119201	83	87	95	50	150	33	97	91	35	30	22.22222222
114	Dr	38	M	2119307	84	88	97.33333333	50.6	149	32	99	98	42	35	22.79176514
115	Km	60	F	2119202	82	86	95	50	150	30	85	87	42	36	22.22222222
116	Lx	45	M	2118301	75	83	94.33333333	56	148	33	110	100	37	33	25.56610665
117	Sp	38	M	1906201	78	79	96	56	164	36	89	82	44	31	20.82093992
118	Vj	44	F	2111302	82	82	106	55	156	32	84	90	38	31	22.60026298
119	At	38	M	1917801	84	73	98.33333333	74	163	39	106	103	46	34	27.85200798
120	Ru	60	F	2109902	82	86	96.33333333	82	148	33	110	101	44	39	37.43608473
121	Si	38	F	2317801	76	80	90.33333333	72	152	38	98	106	47	39	31.1634349
122	Gn	55	F	2109402	70	74	87.33333333	58	145	32	107	117	45	36	27.5862069
123	Bb	58	F	2114302	65	76	82	48.5	160	30	67	78	35	29	18.9453125
124	Rb	41	M	1904002	82	89	97.33333333	73	160	38.5	107	97	40	37	28.515625
125	Rt	44	M	2605801	111	97	126	87	149	36	112	101	43	32	39.18742399
126	Rd	40	F	2022304											
127	Sl	38	F	2023002											
128	At	70	M	2111001	90	86	103.6666667	50	168	34	82	86	42	32	17.7154185
129	Rj	45	F	2613202											
130	Rh	54	F	2103002	84	80	100	63	147	34	86	97	38	31	29.1545885
131	Ml	37	F	2106802	84	79	96.66666667	47	161	30	70	83	40	32	18.13201651
132	Sk	50	M	2308001	89	73	104.6666667	46	149	34	100	94	36	33	20.71978874
133	Sh	35	F	2011902	87	87	110.3333333	61	163	37	95	91	40	33	22.95908766
134	Sv	50	F	2520802											
135	Rm	44	F	1906102	92	70	110	52	161	32	79	80	37	29	20.06095444
136	An	34	F	2312504											
137	Pr	50	F	2020301	83	69	98.66666667	45.5	155	39	85	87	36	29	18.93860562
138	Ca	35	M	2117603	81	79	93.66666667	50	145	31	91	128	43	39	23.78121284
139	Rl	33	M	2705503	84	87	100	58	157	37	96	94	40	32	23.53036634
140	Nu	38	M	2302902	79	76	95.33333333	62.5	161	36	98	93	40	34	24.11172408
141	Ps	43	M	2316601	89	82	103.6666667	76.4	169	40	103	98	46	35	26.74976366
142	Ak	35	M	2117603											
143	Ru	49	M	2316001											
144	Ad	45	M	2320901											
145	Dl	85	M	2100701											
146	Rd	75	M	2112001	67	86	98.66666667	51	153	34	81	91	43	32.5	21.78649237
147	Ak	32	M	2323001											
148	Mj														